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The Correlation Between Memory and Perception in the Presence of Diffuse Cortical Degeneration

BY

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INTRODUCTION

In the previous monograph entitled Imagery and Meaning in Memory and Perception, we have given an analysis of the more intimate structure of memory and perception. We there touched upon the relative mnemonic value of objects, pictures and words with both normal and abnormal subjects.

In making these experiments I noticed, with some of the abnormal subjects, a certain difficulty in the interpretation of pictures. Sometimes, what seemed to me very easy presented to my patients great and even insurmountable difficulty. One case of *dementia senilis* could not be used because there were not pictures enough in my material which the subject could interpret to make it possible to obtain the desired comparisons. And still this old lady could read with the aid of the same spectacles that she used in looking at the pictures. There seemed to be a genuine difficulty of interpretation over and above any mere weakness of vision.

There was thus suggested the interesting problem: how far and to what extent do disturbances of memory go hand in hand with decreasing ability to perceive.

To investigate this problem one might choose cases of more or less definite focal brain lesions or patients suffering from some form of diffuse cortical degeneration. Both types of material would be very interesting to investigate. The study of focal lesions in sufficient number would probably have to be stretched over a considerable period of time because of the relative rarity of their occurrence—although if one had access now to the military hospitals abroad sufficient material might readily be obtained. Conditions involving diffuse cortical degeneration, on the other hand, are relatively common and any large asylum will provide ample material.

One of the interesting problems that such a study should throw light on is this: Are memory and perception functions intimately connected with two different definitely localizable

cortical centers or with one and the same cortical center, or are they functions of the cortex as a whole?

If they are functions of two different centers, one should find in the history of cortical lesions cases in which, in spite of the afferent pathways remaining intact, either perception or memory could be very seriously affected without the other being involved. Cases of sensory aphasia would offer a very interesting set of material on which to experiment. If, however, we are to believe von Monakow[1] there is no case of aphasia or agnosia in which the condition permanently remains, unless there is at the same time a *diffuse* cortical degeneration. If von Monakow is right, then it would seem that all "gnostic" functions pertain to the cortex as a whole and not to any center or centers in the brain.

If memory and perception were functions of a single center we should expect that the profoundest mental changes would follow the destruction of some definitely localizable area in the brain, while other functions, such as movement, respiration, various reflexes, etc., would remain intact. A condition such as this is not, however, known to exist—if we rule out the effects which might be due to the all-reverberating influence of shock.

If memory and perception are not definitely localizable in circumscribed areas of the brain, but are functions of the whole cortex, as von Monakow maintains, then one would expect a high correlation between the disturbances of memory and perception in patients suffering from any form of diffuse cortical degeneration.

One would expect it, but not necessarily find it. The action of drugs and toxines is so selective that we must allow for the possibility, or rather the probability, that the cortex considered as a unit organ may suffer impairment in one or more of its functions while the others remain relatively intact.

In spite of the various possible interpretations of results, the study of the correlation of functions in pathological conditions of the cortex is a hopeful field of study, and one in which very

[1] Die Lokalisation im Grosshirn Wiesbaden 1914, p. 479 and p. 693 ff.

little has as yet been done. It should eventually be supported by the results of autopsy, and when this is done we may expect considerable light on the nature and localization of cortical function.

Furthermore, one may expect some light on the problem of mental functions in general—a problem which only in the last few years has emerged from the primitive state of metaphysical affirmations and denials. So far the empirical study of mental faculties has confined itself mainly[2] to normal subjects.

But there is a certain advantage in choosing abnormal rather than normal subjects for such a study. Owing to the crudeness of our methods of measurement, the errors of observation are relatively large, as compared, let us say, with exact physical studies. The result is that correlation tends to be swamped by the large experimental errors. When, however, we choose pathological cases we get a much wider dispersion of values than obtains among normal subjects. Hence the errors of observation are not as serious an obstacle as they are among subjects whose abilities approach more closely to one and the same level.

CHAPTER I

Method of Experiment

The technique of these experiments is similar to that observed in the preceding monograph. That is to say, I used for memory: real objects, pictures of objects, printed and spoken words referring to real objects of ordinary every-day experience.

In each of the four types of memory series eight individual things were exposed without the aid of apparatus—one at about every two seconds. The series was given but once, and then the subject was called upon to repeat as much of it as he could without regard to the original order of presentation. When he gave up hope of going further, I kept him busy answering such questions as "What is 3+7? 9×3," etc., gauging the difficulty

[2] But confer hereon the very interesting study of Hart and Spearman. Mental Tests of Dementia. Journal of Abnormal Psychology, 1914-15, IX, Pp. 217-264.

of the sums by the ability of the subject. When one minute of this work had elapsed I asked him again to tell me what he could remember of the series. At any one sitting eight series were taken—two each for objects, pictures, printed and spoken words. Two sittings were held for every subject—except one, who had been let out on parole when I called for him the second time. None of the objects, pictures and words used in one series were repeated in any of the others.

Two measures of memory were thus obtained: (a) the number of objects, pictures, and words recalled immediately; (b) the ratio of what was remembered after one minute to the value obtained for immediate memory.

In either the first or the second of the two sittings, but generally the first, the test of perception was made. This consisted in having the patients name, as quickly as they could, a picture laid before them. I used 50 pictures in all. None of the pictures used in memory was used in preception. As soon as I uncovered the picture I started a stop-watch. As soon as the subject named the picture or made an effort to speak, or showed by his expression or behavior that he knew what the picture was I stopped the watch, recording the name given. I stopped the watch at the first evidence of recognition because I wished to measure perception, not the ability to name. Though some error is here involved, the average of the whole series of 50 reactions gives a very fair measure of the patient's ability to interpret pictures, and this is what I mean here by perception.

The name given by a subject was not always correct. Though I have recorded the name in every instance, I have made no deduction for incorrect judgments. Some, for instance, would be more correct than others. Thus, it is not as serious an error to call a turkey a rooster or a peacock (especially when a patient may not have seen live turkeys very often) as to call a crown a flower vase, a drum a water vessel, or a finger a fish. There were very few interpretations that bore no resemblance to the objects interpreted. Thus, for instance, the chain does not look altogether unlike a sausage, nor is the mask very different from

a face, etc. In general, a wrong interpretation was a slow one, and I have considered the delay in reaction a sufficient penalization for the error, hoping that the average of the 50 reactions would on the whole give a fair measurement.

It would be inadvisable, however, to neglect the absolute failures to give any interpretation at all. One could take merely the average of the number interpreted, but in so doing one would leave out of consideration a very important evidence of disability. After the consideration of various possibilities I concluded that a very fair measurement could be obtained by regarding perception as equal to the ratio of the per cent. interpreted to the reaction time. Thus perception would be considered as varying directly with the percentage of interpretations and indirectly with the reaction time. This measure was accordingly adopted.

The subjects that I studied were inmates of the institutes of Egelfin and Haar, in the neighborhood of Munich. They were all of the same race and belonged to the class of Bavarian laborers and tradesmen. Except for one ament they were all suffering from *Dementia paralytica, Dementia senilis,* or *chronic alcoholism,* all of which conditions produce diffuse though not identical cortical impairment. It would have been better to confine the studies to some one form of mental disease. But sufficient material would scarcely have been obtained. Cases that were very far advanced could not be used. Every patient who was at all unwilling to coöperate I thought it best to exclude. There is no use of trying persuasion or intimidation by the authorities. A variation in willingness to cooperate would have introduced a disturbing factor that could scarcely be eliminated. So, as soon as a patient manifested this unwillingness either by suspicion or moroseness, or fear of showing his incapacity, or for any other reason, I left him and went to the next man on the list. Some were very willing to name the pictures but shrunk from the effort to recall. These, of course, had to be excluded. With a few we got along famously together for a while, and then, all of a sudden, they would exasperatingly refuse to go further. As a result, a rather

long list dwindled down to the 30 subjects reported in this study. I had intended to carry the experiments still further, but the work was interrupted by the outbreak of the war in August, 1914.

I chose men and excluded women to make the group as homogeneous as possible. The familiarity of men and women with the objects of daily life varies with the objects. Women are more familiar with household things, men are better acquainted with tools and implements. Though, with normal individuals, this might make no difference, with pathological cases it might be a disturbing factor. I thought it best to run no risks and keep the cases as homogeneous as possible.

By way of comparison between normal and abnormal subjects I started an investigation of the same nature on young men belonging to the same state of life, chosen from a Verein of laborers of various trades in Munich.

After having experimented on only six subjects, this investigation had to be stopped on account of the outbreak of the war.

The data are given below, the subjects following in the memory table in alphabetical order. In the tables for memory, M refers to the things remembered, Z to the time consumed in repetition. The lists of "things mentioned which were not present" following each table are arranged in separate series. Those following the number "1" refer to the first series of tests, those following the number "2" the second series, and so on.

In the tables for perception the data follow in the order of time of experiment. The name at the head of each page of data refers to the institution of the patient. The top line gives the date of the experiment, the next line the name of the subject. The reaction times are given in two columns for each subject, those between 0-1.8 seconds and those above 2.00. *Brackets surrounding figures indicate not a reaction time, but the time during which the subject tried to interpret a picture that he finally failed to name at all.*

The totals have been proved by adding the vertical and horizontal columns and taking a grand total, which, of course, must

be the same for both. The transverse additions not only enable us to check the vertical, but also give a means of finding out what are the most difficult pictures. One will see, I think, by referring to the pictures,[1] that the difficulty is not one of acuity of vision, but of interpretation.

The ten pictures most often uninterpreted were: bed, letter, finger, candle, trunk, nose, nest, sled, snail, bird. The ten with the longest reaction times are: acorn, finger, candle, lily, nose, nest, rose, sled, cradle, sausage. I think, if one refers to the pictures, he will see they are not such as require greater acuity of vision than the others. Take, for instance, the subject Listle. He failed to interpret pretzel, letter, frog, chain, trunk, lily, nose, sled, grapes, turkey, bird, cradle. With him I happen to have a measurement of his visual acuity. Estimated by Landolt's rings, his vision, measured at three metres from the rings, was just 0.5 normal. One who could see the opening of the circle at 15 feet and indicate its direction should have little trouble in naming the pictures placed before him at reading distance, if visual acuity alone were concerned.

[1] These pictures were printed in the Psychological Review, 1915, XXII, pp. 182-188.

CHAPTER II

Experimental Data

A. ABNORMAL SUBJECTS

JOSEPH AIDLSBURGER. 42 years old. MALER. PARESIS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
20/IV	4	83	4	53	4	44	5	67	7	94	6	34	4	28	1	34
20/IV	4	29	6	62	3	20	1	39	3	29	1	19	7	61	0	—
22/IV	5	36	3	24	6	19	4	23	3	22	0	—	3	19	1	7
22/IV	6	39	4	30	6	20	1	16	5	16	0	—	5	22	2	26
Total	19	187	17	169	19	103	11	208	18	161	7	53	19	130	4	77
SZ/M		9.8		9.9		5.4		18.9		8.9		7.5		6.8		19.2

Things named immediately..... 75

Things named after 1 minute..... 39

Ratio $\frac{39}{75} = .520$

Things mentioned that were not present:

1) Pickel, Aal, Wage, Sofa, Mädl -Puppe.
2) Schwamm, Korb, Zange.
3) Pferd, Löffel, Pfeil.
4) Pinsel, Mond.
Total: 13.

ANTON BACH. 44 years old. KIRCHENMALER UND VERGOLDER. PARESIS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
23/IV	4	50	4	16	3	44	3	23	1	62	0	..	3	68	0	..
23/IV	5	32	5	39	4	36	5	100	3	16	2	29	2	27	1	11
25/IV	5	66	4	42	4	26	4	51	2	8	0	..	1	48	0	..
25/IV	4	18	5	47	4	40	4	42	2	53	0	..	3	13	0	..
Total	18	166	18	144	15	146	16	216	8	139	2	29	9	156	1	11
SZ/M																

Things named immediately..... 50

Things named after 1 minute..... 37

Ratio $\frac{37}{50} = .740$

Things mentioned that were not present:

1) Maler, Nadel.
2) Zwirn.
3) Schlüssel, Glocke, Herz, Schlüssel, Glocke.
Total: 19.
4) Schiff, Bürste, Stuhl, Tisch, Stuhl, Stern, Messer, Schuh, Löffel, Löwe, Storch.

HEINRICH BAUER. KÜRSCHNER. 57 years old. DEMENTIA SENILIS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
9/V	6	72	0	..	6	40	0	..	3	48	2	22	4	46	0	..
9/V	3	47	0	..	6	26	2	45	5	39	2	51	2	9	0	..
9/V	4	16	0	..	2	16	1	21	3	18	0	..	1	23	0	..
9/V	4	26	0	..	2	8	0	..	3	43	0	..	3	14	0	..
Total	17	161	0		16	90	3	66	14	148	4	73	10	92	0	
SZ/M		9.5				5.6		22.0		10.6		18.2		9.2		

Things named immediately..... 57

Things named after 1 minute..... 7

Ratio $\frac{7}{57} = .123$.

Things mentioned that were not present:

1) Schere.
2) Schlüssel, Schlüssel, Zwirn.
3) Hand, Wiege, Kartoffel, Bügeleisen.
4) Messer, Kanone, Vogel.

Total: 11.

HANS BISCHOFF. GASTWIRT. PARESIS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
26/VI	6	35	5	29	3	11	2	13	3	14	2	14	3	15	0	..
26/VI	4	62	3	67	3	8	3	48	4	9	0	..	3	8	0	..
1/VII	4	20	0	..	4	19	0	..	3	9	0	..	2	35	0	..
1/VII	5	38	1	36	4	38	0	..	4	9	0	..	3	14	0	..
Total	19	155	9	132	14	76	5	61	14	41	2	14	11	72	0	..
SZ/M		8.2		15.0		5.4		12.2		2.9		7.0		6.5		

Things named immediately..... 58

Things named after 1 minute..... 16

Ratio $\frac{16}{58} = .276$.

Things mentioned that were not present:

1) Zeiger, Messer-Messer, Zange, Bürste, Puppe, Kravatte.
2) Nagel.
3) Hobel, Schlüssel, Trichter.
4) Schiff.

Total: 11.

JOSEPH BISSINGER. 63 years old. KORSAKOFF.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
20/IV	4	14	3	28	3	17	1	26	4	33	1	5	2	26	0	..
20/IV	4	25	2	30	3	19	3	15	3	18	2	26	2	12	0	..
22/IV	3	9	1	24	3	27	2	28	1	12	0	..	3	16	0	..
22/IV	5	26	1	8	3	14	0	..	3	28	1	13	5	15	0	..
Total	16	74	7	90	12	77	6	69	11	91	4	44	12	69	0	..
SZ/M		4.6		12.9		6.4		11.5		8.3		11.0		5.7		

Things named immediately..... 51

Things named after 1 minute..... 17

Ratio $\frac{17}{51} = .333.$

Things mentioned that were not present:

1) ....., ...

2) Glas, Glas, Hammer, Hammer. Hammer in previous series. *Glas* pertains perhaps to *Fernglas* in the previous series.

3) Aal, Gabel, Gabel, Pfeil, Schere, Gabel, Schere, Gabel, Schere.

4) Gabel, Gabel, Gabel, Gabel, Hammer, Pfeil, Hobel.
Total: 16.

AUGUST BOLZ. 34 years old. OBERKELLNER.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
22/VII	7	30	7	33	5	48	5	24	4	41	3	47	4	12	1	17
22/VII	7	52	6	13	5	29	5	17	4	12	3	19	4	5	0	..
29/VII	7	34	6	19	4	14	3	33	4	23	3	19	5	16	5	34
29/VII	6	38	6	39	6	11	4	14	4	22	3	8	4	19	1	18
Total	27	154	25	104	20	102	17	88	16	98	12	93	17	52	7	69
SZ/M		5.7		4.2		5.1		5.2		6.1		7.7		3.1		9.8

Things named immediately..... 80

Things named after 1 minute..... 61

Ratio $\frac{61}{80} = .762.$

Things mentioned that were not present:

1) Uhr, Trompete, Hammer, Ohr, Zähne, Gesicht.

2) Herz, Bruch, Gesicht, Gefühl, Gehör, Bogen.

3) Stuhl.

4) Pfeil, Bohrer, Schwamm, Zange, Seife, Hand, Gesicht, Gehor, Besen.
Total: 22.

WILHELM FLECHSEL. KAUFMANN. 60 years old. DEMENTIA SENILIS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
10/VI	5	43	4	24	5	57	5	30	3	17	1	17	3	29	0	..
10/VI	4	19	2	52	6	32	1	34	2	15	1	11	3	10	2	15
13/VI	6	26	3	31	5	43	6	39	4	48	1	8	0	..	0	..
13/VI	5	67	3	26	4	30	4	43	3	45	2	15	4	19	1	17
Total	20	155	12	133	20	162	16	146	12	125	5	51	10	58	3	32
SZ/M		7.7		11.1		8.1		9.1		10.4		10.2		5.8		10.7

Things named immediately..... 62

Things named after 1 minute..... 36

Things mentioned that were not present:

1) Trichter.
2) Pinsel.
3) .....
4) Korb.

Total: 3.

Ratio $\frac{36}{62} = .581.$

JOSEPH GRAMMINGER. 38 years old. KONDITOR. PARESIS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
30/V	6	34	7	26	8	48	7	24	5	25	2	7	5	24	3	15
30/V	7	20	6	24	6	28	6	29	6	38	4	26	5	14	5	32
Total	13	54	13	50	14	76	13	53	11	63	6	33	10	38	8	47
SZ/M		4.2		3.9		5.4		4.1		5.7		5.5		3.8		5.9

Things named immediately..... 48

Things named after 1 minute..... 40

Nothing mentioned that was not present.

Total: 0.

Ratio $\frac{40}{48} = .833.$

EDWARD GRAVETSCHKY. 45 years old. KONDITOR.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
15/VII	6	46	6	30	6	48	6	39	4	23	4	34	4	38	2	67
15/VII	5	64	4	55	6	44	5	34	5	23	3	62	5	31	1	13
22/VII	6	57	6	24	7	67	6	34	5	25	6	58	6	23	4	44
22/VII	6	72	0	..	6	63	6	56	6	59	3	23	5	19	2	34
Total	23	239	16	109	25	222	23	163	20	130	16	177	20	111	9	158
SZ/M		10.4		6.8		8.9		7.1		6.5		11.1		5.5		17.6

Things named immediately..... 88

Things named after 1 minute..... 64

Ratio $\frac{64}{88} = .727.$

Things mentioned that were not present:

1) Anker, Glocke.
2) ....., ...
3) Lyra.
4) ....., ...

Total: 3.

F. X. KAMMERMAIER. 58 years old. BÄCKER. KORSAKOFF.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
22/VII	2	10	0	..	2	27	0	..	0	..	0	..	2	14	0	..
22/VII	2	19	0	..	1	9	0	..	0	..	0	..	2	14	0	..
22/VII	1	?	0	..	1	6	0	..	1	19	0	..	1	11	0	..
22/VII	1	9	0	..	1	9	0	..	0	..	0	..	2	16	0	..
Total	6	38	0	..	5	51	0	..	1	19	0	..	7	55	0	..
SZ/M		6.3				10.2				19.0				7.9		

Things named immediately..... 19

Ratio $\frac{0}{19} = 0.$

Things named after 1 minute..... 0

Named no words, pictures, nor objects that were not present.

JOHANN KRAUSS. 57 years old. TAPEZIERER. KORSAKOFF.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
20/IV	3	29	2	81	5	40	2	88	5	74	4	54	5	18	4	15
20/IV	2	48	1	41	4	27	2	24	4	48	3	29	2	38	1	7
22/IV	4	16	2	27	4	64	0	..	5	38	4	39	3	43	1	11
22/IV	2	11	1	15	4	68	0	..	2	32	1	59	3	18	0	..
Total	11	104	6	164	17	199	4	112	16	192	12	181	13	117	6	33
SZ/M		9.5		27.3		11.7		28.0		12.0		15.7		9.0		5.5

Things named immediately..... 57

Things named after 1 minute..... 28

Ratio $\frac{28}{57} = .491.$

Things mentioned that were not present:

1) Uhr, Kirsche, Kirsche, Hund, Apfel, Uhr, Glas, Faden, Stiefel, Ring, Kirche, Stifel, Kanne, Rettich.
2) Schaufel, Uhr, Stiefel, Stiefel, Waage, Stiefel, Stiefel, Flasche, Hammer, Bürste, Uhr, Stiefel Harfe, Kanone, Uhr, Wage.
3) Löffel, Löffel, Uhr, Würfel, Stiefel, Schaukel, Schaukel, Kamm, Löffel, Spaten.
4) Löffel, Löffel, Stiefel, Stiefel, Uhr, Ring, Stiefel, Löffel, Würfel, Veilchen, Uhr, Gabel, Kamm, Pfeil, Uhr, Ring, Hammer, Würfel, Vogel, Schuh, Licht, Licht, Würfel, Stiefel, Uhr.

Total: 57.

ALOIS LANG. 28 years old. BÄKER. SCHWACHSINNIGER.

	OBJECTS				PICTURES				SPOKEN WORDS				PRINTED WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
22/IV	8	61	5	26	6	58	5	24	4	25	3	16	4	24	0	..
22/IV	7	41	6	46	4	26	3	15	4	40	3	24	4	19	0	..
23/IV	8	44	8	58	6	29	6	41	5	34	4	27	5	29	3	27
23/IV	7	28	6	19	5	73	4	36	3	17	3	29	6	26	5	26
Total	30	174	25	149	21	186	18	116	16	116	13	96	19	98	8	53
SZ/M		5.8		6.0		8.9		6.4		7.2		7.4		5.2		6.6

Things named immediately..... 86

Things named after 1 minute..... 64

Ratio $\frac{64}{86} = .744.$

Things mentioned that were not present:

1) .....
2) .....
3) .....
4) Schilling. Pertains perhaps to Schädl.

Total: 1.

JOSEPH LISTLE. 70 years old. SCHUHMACHER. ALCOHOLISMUS CHRONICUS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
22/V	3	8	3	23	3	8	3	21	2	15	2	10	3	11	2	48
22/V	4	31	5	27	2	16	2	14	3	14	0	..	2	41	0	..
27/V	4	26	1	40	2	15	2	8	2	10	2	12	4	6	0	..
27/V	4	8	1	12	2	8	0	..	2	16	1	21	2	6	0	..
Total	15	73	10	102	9	47	7	43	9	55	5	43	11	64	2	48
SZ/M		4.9		10.2		5.2		6.1		6.1		8.6		5.8		24.0

Things named immediately..... 44

Things named after 1 minute..... 24

Ratio $\frac{24}{44} = .545$.

Things mentioned that were not present:

1) Schere, Schere.
2) Hammer, Hammer, Schere, Hammer, Schere, Hammer, Schere, Puppe, Spiess, Hammer.
3) Schlüssel, Meissel.
4) .....

Total: 14.

JOSEPH MEHLSTRETTER. SCHNEIDER. 63 years old. ALCOHOLISMUS. CHRONICUS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
16/5V	7	63	7	38	5	27	6	25	4	12	4	31	4	17	4	47
16/5V	7	73	6	36	4	36	4	38	6	75	2	55	6	23	3	67
20/V	6	23	5	39	6	48	5	22	5	55	1	7	5	14	3	13
20/V	4	13	2	12	6	26	5	24	6	74	4	58	5	14	3	18
Total	24	172	20	125	21	137	20	109	21	216	11	151	20	68	13	145
SZ/M		7.2		6.2		6.5		5.4		10.3		13.7		3.4		11.2

Things named immediately..... 86

Things named after 1 minute..... 64

Ratio $\frac{64}{86} = .744$.

Things mentioned that were not present:

1) .....
2) Giesskanne, Katze, Fahne, Fahne.
3) Viereck, Viereck, Hake, Hake.
4) Mädl, Hirsch.

Total: 7.

ANTON MÜLLER. 46 years old. LABORATORIUM DIENER (CHEMIE). PARESIS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
13/VI	5	52	0	..	4	27	0	..	3	38	0	..	3	21	0	..
13/VI	1	11	0	..	6	27	1	35	2	20	0	..	4	13		..
20/VI	3	13	0	..	5	28	3	64	1	9	0	..	4	21	0	..
20/VI	3	18	0	..	3	13	0	..	2	12	0	..	4	19	0	..
Total	12	94	0	..	18	95	4	99	8	79	0	..	15	74	0	..
SZ/M		7.8				5.3		24.7		9.9				4.9		

Things named immediately..... 53

Things named after 1 minute..... 4

Ratio $\frac{4}{53} = .075$.

Things mentioned that were not present:

1) Messer.
2) .....
3) Kanapee, Schraube, Kanapee.
4) .....

Total: 4.

SAMUEL NEUMANN. GESCHÄFTSREISENDER. PARESIS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
26/VI	6	105	4	58	5	18	2	19	3	21	2	16	2	8	1	25
26/VI	5	20	1	29	5	16	2	31	4	11	0	..	5	11	0	..
1/VII	3	8	1	61	3	12	2	37	5	20	2	14	4	24	0	..
1/VII	5	44	2	63	3	14	0	..	2	3	1	9	5	18	0	..
Total	19	177	8	211	16	60	6	87	14	55	5	39	16	61	1	25
SZ/M		9.3		26.4		3.7		14.5		3.9		7.8		3.8		25.0

Things named immediately..... 65

Things named after 1 minute..... 20

Ratio $\frac{20}{65} = .308$.

Things mentioned that were not present:

1) Glas, Grosse Puppe, Messer, Zahnbürste, Schere, Mädl, Grosses Mädl, Messer, Leuchter, Behru Walu, Mili, Wili, Fili, Faleru, What you spoke always ended in L. The series was: 'Feile, Löffel, Uhr. Katze, Horn, Sichel, Besser, Flasche.
2) Halsband, Hammer, Zahnbürste, Lineal, Bürste, Mädl, Puppe, Gläschen, Kerzenleuchter Schere, Kanne, Schlüssel, Korb, Bügeleisen, Haken, Haken, Schlüssel, Ring, Brunnen, Leuchter, Schere, Körbschen, Zange, Hammer, Schreibzeug, Hand, Kafemühtle, Dampfschiff, Fali, Fale, Wili.
3) Handbürste, Schere, Schlüssel, Schlüssel, Schere, Aal, Pfau, Meissel, Schere, Aal, Messer, Hand, Hammer, Messer, Schubkarren, Violine, Violine, Aal, Meissel, Pfeife.
4) Schreib-feder, Haken Bleistift, Dachshund, Aal, Meissel, Wickelkindschen, Bleistift, Korb, Ring, Eule, Spiegel, Kamel.

Total: 76.

JOSEPH ROHR. 31 years old. SCHLOSSER. PARALYSE.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
6/VI	3	19	1	1	4	63	0	..	1	39	0	..	2	47	1	..
6/VI	2	69	3	49	2	31	0	..	2	34	0	..	2	58	0	..
10/VI	4	75	1	63	3	36	3	21	4	21	1	57	3	57	0	..
10/VI	2	61	0	..	1	12	0	..	4	90	0	..	2	27	0	..
Total	11	224	5	113	10	142	3	21	11	184	1	57	9	189	1	..
SZ/M		20.3		22.6		14.2		7.0		16.7		57.0		21.0		

Things named immediately..... 41

Things named after 1 minute..... 10

$$\text{Ratio } \frac{10}{41} = .244.$$

Things mentioned that were not present:

1) Schiff, Stern, Löwe.
2) Spiegel, Schiff, Hammer, Damenuhr, Zange.
3) Stier.
4) Zange, Kanone, Pinsel, Stier, Hobel, Spiegel.

Total: 15.

LEONHARD RUSS. 74 years old. NAGERCHMIDTMEISTER. KORSAKOFF.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
25/IV	2	33	1	32	3	28	3	33	0	..	0	..	0	..	0	..
25/IV	2	4	0	..	0	..	0	..	3	14	0	..	3	10	0	..
29/IV	3	26	0	..	4	24	3	36	2	19	0	..	1	4	0	..
29/IV	2	16	0	..	3	19	0	..	1	..	0	..	2	14	0	..
Total	9	79	1	32	10	71	6	69	6	33	0	..	6	28	0	..
SZ/M		8.8		32.0		7.1		11.5		5.5				4.7		

Things named immediately..... 31

Things named after 1 minute..... 7

$$\text{Ratio } \frac{7}{31} = .226.$$

Things mentioned that were not present:

1) Storch, Gockel. This word was named as one of the given objects. Thereupon I asked: "Did I present a real rooster?" Answer: "I believe so."
2) Pinsel, Gockel, Messer.
3) Fisch, Kamm.
4) .....

Total: 7.

SEBASTIAN SCHREMSER. 69 years old. SCHREINER. ALKOHOLISMUS CHRONICUS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
16/V	5	25	4	12	6	50	4	10	2	12	3	14	2	9	0	..
16/V	5	18	3	16	5	63	4	22	4	12	4	21	4	24	4	28
20/V	5	21	3	26	3	11	3	21	4	45	4	47	2	12	1	10
20/V	4	28	2	8	3	9	1	28	2	9	0	..	4	9	1	24
Total	19	92	12	62	17	133	12	81	12	78	11	82	12	54	6	62
SZ/M		4.8		5.2		7.8		6.7		6.5		7.5		4.5		10.3

Things named immediately..... 60

Things named after 1 minute..... 41

Ratio $\frac{41}{60} = .683$.

Things mentioned that were not present:

1) ....., ...
2) ....., ...
3) Beisszange.
4) Beisszange, Feile, Ring.

Total: 4.

HANS SEUFFERT. KAUFMANN. 42 years old. PARESIS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
2/V	3	9	2	19	3	27	1	10	4	9	1	13	3	6	0	..
2/V	3	12	0	..	4	33	2	17	4	24	0	..	4	18	0	..
6/V	2	33	0	..	4	14	1	13	4	7	0	..	3	4		..
6/V	1	5	1	10	4	7	0	..	4	8	0	..	5	12	0	..
Total	9	59	3	29	15	81	4	40	16	48	1	13	15	40	0	..
SZ/M		6.6		9.7		5.4		10.0		3.0		13.0		2.7		

Things named immediately..... 55

Things named after 1 minute..... 8

Ratio $\frac{8}{55} = .145$.

Things mentioned that were not present:

1) Feile, Hammer, Meissel, Bleistift, Feile, Lineal, Kind, Fisch, Kamel.
2) Lineal, Lineal, Bleistift, Zange, Lineal, Apfel, Ochs, Lineal, Kind, Ochs, Kamel, Lineal.
3) Kuh, Ochs, Geldbeutel, Lineal.

Total: 24.

OTTO STEIGER. KAUFMANN. 48 years old. PARESIS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
9/V	3	9	3	24	4	26	2	7	2	4	1	21	4	73	4	46
9/V	2	5	3	38	4	19	1	14	3	10	2	22	5	23	2	19
12/V	6	46	3	34	3	30	1	30	2	5	2	15	4	8	2	12
12/V	7	38	3	8	4	18	3	15	2	5	0	22	5	13	0	..
Total	18	98	12	104	15	93	7	66	9	24	5	80	18	117	8	77
SZ/M		5.4		8.7		6.2		9.4		2.7		16.0		6.5		9.6

Things named immediately..... 60

Things named after 1 minute..... 32

Ratio $\frac{32}{60} = .533.$

Things mentioned that were not present:

1) Bürste.
2) Besen, Pickel.
3) Stuhl,Schiff, Lokomotive, Vogel.
4) Hut, Gockel.

Total: 9.

IGNATIUS STOSSBERGER. HAUSARBEITER. 69 years old. ALKOHOLISMUS CHRONICUS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
16/V	5	50	4	20	4	33	5	18	2	11	0	..	3	24	0	..
16/V	4	62	0	..	4	34	0	..	3	7	0	..	5	44	0	..
20/V	3	16	4	39	4	48	2	38	3	14	2	18	5	20	0	..
20/V	3	48	0	..	5	27	0	..	2	29	0	..	2	14	0	..
Total	15	176	8	59	17	142	7	56	10	61	2	18	15	102	0	..
SZ/M		11.7		7.4		8.4		8.0		6.1		9.0		6.8		

Things named immediately..... 57

Things named after 1 minute..... 17

Ratio $\frac{17}{57} = .298.$

Things mentioned that were not present:

1) .....
2) .....
3) Kanapee.
4) .....

Total: 1.

JOSEPH UHRMANN. INSTALLATIONSARBEITER. ALKOHOLISMUS. CHRONICUS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
16/V	5	47	4	33	3	42	1	22	3	14	0	..	5	28	1	21
16/V	6	42	2	48	2	8	0	..	4	14	0	..	4	12	0	..
20/V	3	11	0	..	4	18	0	..	5	46	1	24	4	18	0	..
20/V	3	29	0	..	4	16	0	..	4	11	0	..	4	14	0	..
Total	17	129	6	81	13	84	1	22	16	85	1	24	17	72	1	21
SZ/M		7.6		13.5		6.5		22.0		5.3		24.0		4.2		21.0

Things named immediately 63

Things named after 1 minute..... 9

Ratio $\frac{9}{63} = .143.$

Things mentioned that were not present:

1) ....., ...
2) **Spiegel.**
3) Wage, Messer.
4) .....

Total: 3.

JOHANN VETTER. KESSELSCHMIDT. 49 years old. PARESIS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
30/V	2	8	2	10	4	14	3	24	2	6	2	12	3	5	0	..
30/V	4	34	3	24	4	18	1	36	3	4	0	..	2	7	0	..
6/VI	5	36	6	61	5	27	2	37	3	10	2	13	3	9	2	8
6/VI	4	13	4	6	3	38	2	16	3	11	1	18	2	4	0	..
Total	15	91	15	101	16	97	8	113	11	31	5	43	10	25	2	8
SZ/M		6.1		6.7		6.1		14.1		2.8		8.6		2.5		4.0

Things named immediately..... 52

Things named after 1 minute..... 30

Ratio $\frac{30}{52} = .577.$

Things mentioned that were not present:

1) Uhr, Schere.
2) Bügeleisen, Bügeleisen, Leuchter, Brunnen.
3) ....., ...
4) Spiegel.

Total: 7.

KARL WAHLRAB. 34 years old. ELEKTROTECHNISCHER KORRESPONDENT. PARESIS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
14/VI	5	32	4	31	8	51	8	63	4	14	4	13	6	18	6	31
14/VI	6	84	6	35	5	62	4	67	4	26	3	13	3	12	4	22
20/VI	6	29	6	36	5	24	4	24	5	18	3	34	5	39	2	49
20/VI	6	39	6	69	5	39	3	20	4	13	2	46	6	7	0	..
Total	23	184	22	171	23	176	19	174	17	71	12	106	20	76	12	102
SZ/M		8.0		7.8		7.7		9.2		4.2		8.8		3.8		8.5

Things named immediately..... 83

Things named after 1 minute..... 65

Ratio $\frac{65}{83} = .783.$

Things mentioned that were not present:

1) Schere, Zange.
2) Seife, Massstab, Schraubenzieher, Kirsche, Zange, Uhr, Wage, Stier.
3) Hahn, Hahn, Stier.
4) Tasse, Schwan.

Total: 14.

GEORG WALLNER. 54 years old. KORSAKOFF.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
23/IV	4	41	4	28	5	22	0	..	5	10	0	..	4	8	0	..
23/IV	4	9	3	16	4	40	2	13	3	6	2	19	5	9	1	8
25/IV	4	23	2	16	4	17	0	..	1	18	0	..	3	18	0	..
25/IV	5	24	1	17	3	22	1	63	4	32	0	..	3	11	0	..
Total	17	97	10	77	16	101	3	76	13	66	2	19	15	46	1	8
SZ/M		5.7		7.7		6.3		25.3		5.1		9.5		3.1		8.0

Things named immediately..... 61

Things named after 1 minute..... 16

Ratio $\frac{16}{61} = .262.$

Things mentioned that were not present:

1) Schlüssel, Uhr, Uhr, Schlüssel, Zange, Schuh.
2) Zwirn, Uhr, Wage, Uhr, Zwirn, Zwirn, Schlüssel, Schlüssel, Zwirn, Citrone, Schlüssel.
3) Uhr, Uhr, Bürste, Miss, Orange, Uhr, Uhr, Schlüssel, Bürste, Bürste.
4) Hobel, Pfanne, Schiff, Pfanne, Uhr, Schlüssel, Pfanne, Geige, Bürste, Meissel, Uhr, Schlüssel, Pfanne, Bürste.

Total: 41.

JOHANN WAXLANDER. 50 years old. STEINMETZ. KORSAKOFF.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
25/IV	4	48	1	49	3	56	0	..	4	14	0	..	4	10	0	..
25/IV	3	4	0	..	2	9	0	..	3	7	2	39	4	9	0	..
29/IV	3	9	0	..	2	7	0	..	3	14	0	..	3	14	0	..
29/IV	3	36	0	..	2	25	0	..	2	8	0	..	4	14	0	..
Total	13	97	1	49	9	97	0	..	12	43	2	39	15	47	0	..
SZ/M		7.5		49.0		10.8				3.6		19.5		3.1		

Things named immediately..... 49

Things named after 1 minute..... 3

Ratio $\frac{3}{49} = .061$.

Things mentioned that were not present:

1) Leiter, Lineal.
2) Federhalter, Anker, Anker, Anker, Anker, Anker, Pfeil, Kuh, Fisch, Swicker, Herz, Geige, Kamm, Kamm, Uhr, Haken, Schiff.
4) Anker, Korb, Pferd, Anker, Pfeil, Ahre, Kreide.
Total: 23.

ALBERT WEBER. STAATSFÖRSTVER WALTUNGSDIENST. 62 years old. KORSAKOFF.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
2/V	4	36	3	41	4	15	4	28	3	23	2	12	5	13	0	..
2/V	5	43	4	68	3	35	2	35	2	14	0	..	4	18	1	21
6/V	6	24	4	43	3	18	2	26	3	10	0	..	5	19	0	..
6/V	6	43	4	17	3	33	1	18	4	10	1	8	4	19	0	..
Total	21	146	15	169	13	101	9	107	12	57	3	20	18	69	1	21
SZ/M		7.0		11.3		7.8		11.9		4.7		6.6		3.8		21.0

Things named immediately..... 64

Things named after 1 minute..... 28

Ratio $\frac{28}{64} = .437$.

Things mentioned that were not present:

1) .....
2) Zange, Hammer, Schere, Messer.
3) (Maus, Maus).
4) Kartoffel, Löwe.
Total: 7.

HEINRICH WÜNSCHEIM. 35 years old. LOKOMOTIVFÜHRER. PARESIS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
1/VII	5	18	6	57	6	25	6	65	3	37	3	15	1	5	0	..
1/VII	6	71	6	62	7	93	5	46	3	13	1	24	1	29	0	..
8/VII	6	147	1	38	5	18	2	19	4	22	2	34	3	57	0	..
8/VII	6	59	3	95	6	34	3	18	4	37	2	29	0	..	0	..
Total	23	295	16	252	24	170	16	148	14	109	8	102	5	91	0	..
SZ/M		12.8		15.7		7.1		9.2		7.8		12.7		18.2		

Things named immediately..... 66

Things named after 1 minute..... 40

Ratio $\frac{40}{66} = .606.$

Things mentioned that were not present:

1) Bürste, Buch, Korb.
2) Kirsche, Zeit, Ziel, Zier, Zahl, Ruhe, Auge, Wasser, Zeit, Ziel, Dampfschiff, Orte.
3) Kikalikie, Kikalikie, Vogel, Meissel, Kikalikie, Hut, Ballen.
4) Kartoffel, Schiff, Giesskanne, Kanone, Schraubenzieher, Dampfschiff, Zange, Stern, Stern, Fisch, Fisch, Pfeil, Pfeil, Schiff, Schiff.

Total: 33.

FRANZ XAVIER ZISS. ZIMMERMANN. 66 years old. DEMENTIA SENILIS.

	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
Date	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
2/V	3	44	3	22	2	17	1	15	2	42	2	21	1	26	0	..
2/V	3	22	2	11	2	16	2	23	2	13	1	10	3	17	0	..
6/V	4	24	1	25	4	26	3	18	3	11	2	24	3	24	0	..
6/V	4	27	3	29	2	23	0	..	2	..	0	..	0	..	0	..
Total	14	117	9	87	10	82	6	56	9	66	5	55	7	67	0	..
SZ/M		8.4		9.7		8.2		9.3		7.3		11.0		9.6		

Things named immediately..... 40

Things named after 1 minute..... 20

Ratio $\frac{20}{40} = .500.$

Things mentioned that were not present:

1) Zwicker, Zange, Zange, Hammer, Zange, Puppe.
2) Zange, Zange, Zange, Zange, Hammer, Hammer, Eimer.
3) Gockel, Gockel, Klavier, Klavier.
4) Gieskanne.

Total: 12.

Egelfin

	20/IV		20/IV		20/IV		22/IV		23/IV		23/IV	
	Kraus		Aidlsburger		Bissenger		Lang		Bach		Wallner	
	0–1.8	2.0–00	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00
1. Auge	0.8	—	0.8	—	1.4	—	0.8	—	0.8	—	1.0	—
2. Bär	—	2.8	1.2	—	—	5.6	1.8	—	1.6	—	—	3.2
3. Baum	1.4	—	1.2	—	—	2.2	1.2	—	1.0	—	1.2	—
4. Bett	1.0	—	—	2.0	—	2.2	—	2.6	—	2.0	1.2	—
5. Bretzel	1.0	—	0.8	—	—	2.0	1.0	—	1.0	—	0.8	—
6. Brief	0.8	—	1.2	—	0.8	—	1.0	—	1.0	—	1.2	—
7. Bürste	0.8	—	—	2.8	—	4.2	1.0	—	1.0	—	1.0	—
8. Eichel	1.0	—	1.8	—	—	8.4	1.2	—	1.8	—	1.6	—
9. Ente	1.0	—	1.6	—	—	2.6	—	2.2	1.4	—	1.6	—
10. Esel	1.8	—	1.4	—	1.8	—	1.2	—	0.8	—	1.6	—
11. Eule	1.4	—	1.0	—	—	2.4	1.0	—	1.8	—	1.4	—
12. Fächer	1.4	—	1.0	—	1.4	—	1.0	—	1.8	—	1.6	—
13. Finger	—	2.6	1.2	—	—	(24.0)	1.0	—	1.2	—	—	2.6
14. Frosch	1.4	—	1.2	—	—	2.4	1.4	—	1.2	—	1.4	—
15. Hase	1.4	—	1.2	—	1.8	—	1.0	—	1.2	—	1.4	—
16. Kerze	—	30.0	1.4	—	—	(20.6)	1.4	—	1.8	—	—	9.0
17. Kette	1.6	—	1.2	—	—	2.8	0.8	—	1.0	—	—	2.6
18. Koffer	—	3.4	—	3.6	—	2.2	1.6	—	—	3.4	1.6	—
19. Krebs	1.8	—	1.4	—	—	5.6	1.0	—	1.4	—	1.4	—
20. Krone	1.6	—	1.8	—	—	10.0	1.4	—	1.4	—	—	4.4
21. Lampe	1.0	—	1.0	—			1.0	—	1.0	—	0.8	—
22. Leiter	0.8	—	—	2.0	—	3.0	1.0	—	0.6	—	1.4	—
23. Lilie	—	7.0	—	2.4	—	5.6	1.2	—	—	4.2	—	2.0
24. Maske	1.0	—	1.2	—	—	3.0	—	2.2	1.8	—	1.4	—
25. Maus	—	3.8	1.2	—	—	2.4	1.8	—	1.8		1.6	—
26. Nase	—	(23.0)	1.4	—	—	7.0	—	5.6	—	2.0	1.4	—
27. Nest	1.2	—	1.8	—	—	(11.4)	1.2	—	—	2.2	—	4.6
28. Ofen	1.4	—	1.0	—	1.4	—	1.4	—	1.4	—	1.0	—
29. Rad	0.8	—	0.8	—	1.8	—	0.8	—	0.6	—	0.8	—
30. Ring	—	4.2	1.0	—	—	2.4	1.2	—	1.4	—	1.8	—
31. Rose	—	2.6	1.4	—	—	(26.2)	1.4	—	—	3.8	—	10.2
32. Schaf	1.4	—	1.8	—	—	6.4	1.4		—	2.2	1.8	—
33. Schlange	0.8	—	1.2	—	—	4.6	1.0	—	1.0	—	—	2.0
34. Schlitten	—	3.2	1.4	—	—	5.6	1.6	—	1.4	—	1.4	—
35. Schnecke	1.8	—	1.8	—	—	2.4	1.0	—	1.6	—	1.6	—
36. Schubkarren	—	20.0	1.0	—	—	2.6	1.2	—	0.8	—	1.4	—
37. Schwan	1.2	—	0.8	—	—	3.0	1.4	—	1.8	—	1.0	—
38. Sense	—	5.0	1.4	—	—	3.8	1.4	—	—	2.6	1.6	—
39. Spinne	0.8	—	1.2	—	—	10.9	1.6	—	—	2.0	1.4	—
40. Strumpf	—	2.6	1.0	—	—	3.6	1.6	—	0.8	—	—	2.0
41. Tasche	1.8	—	—	2.0	—	3.6	1.4	—	1.6	—	—	2.0
42. Traube	—	3.0	1.2	—	—	(18.6)	0.8	—	1.2	—	—	4.4
43. Treppe	1.2	—	—	2.6	—	4.2	1.0	—	0.8	—	1.8	—
44. Trommel	1.2	—	1.0	—	—	3.0	1.0	—	1.0	—	0.8	—
45. Truthahn	—	7.0	1.4	—	—	13.0	1.4	—	—	3.0	1.4	—
46. Vogel	1.4	—	1.2	—	1.6	—	1.2	—	—	3.2	1.4	—
47. Wiege	—	2.4	—	2.4	—	2.4	—	2.4	—	2.8	—	2.4
48. Windmühle	1.4	—	1.4	—	—	15.4	1.2	—	1.8	—	—	5.0
49. Wurst	1.8	—	1.8	—	—	3.8	1.4	—	1.0	—	—	4.4
50. Zither	1.8	—	1.0	—	1.4	—	—	3.6	1.2	—	0.8	—
Total	43.0	99.6	52.8	19.8	13.4	164.3	53.4	18.6	47.8	33.4	46.6	60.8
Average	2.9		1.5		4.0		1.4		1.6		2.2	
Correct	98%		100%		90%		100%		100%		100%	

Egelfin

	25/IV		25/IV		2/V		2/V		2/V		13/V	
	Waxlander		Russ		Seuffert		Weber		Ziss		Bauer	
	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00	0–8.	2.00-00	0–1.8	2.0-00	0–1.8	2.0-00
1. Auge	—	2.2	—	2.4	1.0	—	0.8	—	1.4	—	1.0	—
2. Bär	—	3.0	1.6	—	1.8	—	1.4	—	—	3.4	—	2.4
3. Baum	—	3.6	1.4	—	1.2	—	—	2.2	—	4.0	1.6	—
4. Bett	—	(11.0)	—	3.4	1.4	—	1.2	—	—	(14.0)	—	5.4
5. Bretzel	—	2.0	—	2.0	—	4.0	1.4	—	—	3.8	1.4	—
6. Brief	—	2.8	1.8	—	1.0	—	1.2	—	—	(9.8)	1.4	—
7. Bürste	—	3.2	—	2.0	1.6	—	1.0	—	—	3.2	1.4	—
8. Eichel	—	2.6	—	2.8	1.6	—	—	2.4	—	4.0	1.4	—
9. Ente	1.6	—	1.8	—	1.4	—	1.2	—	—	3.6	—	2.6
10. Esel	—	3.6	—	6.0	1.2	—	1.0	—	—	5.2	1.6	—
11. Eule	—	2.4	—	2.4	1.8	—	1.2	—	—	8.4	—	3.0
12. Fächer	—	2.8	—	3.0	1.2	—	1.2	—	—	3.6	1.2	—
13. Finger	—	11.8	—	(20.8)	1.2	—	1.6	—	—	3.8	—	2.0
14. Frosch	—	2.0	—	6.2	1.4	—	1.2	—	1.4	—	1.6	—
15. Hase	1.6	—	1.4	—	1.2	—	1.0	—	—	3.4	—	2.4
16. Kerze	—	5.0	1.2	—	1.8	—	1.8	—	—	3.0	1.4	—
17. Kette	—	7.4	1.8	—	1.0	—	1.4	—	—	5.4	1.4	—
18. Koffer	—	9.6	—	(5.4)	1.0	—	—	3.8	—	4.4	1.2	—
19. Krebs	1.6	—	—	2.2	1.2	—	1.6	—	—	5.0	1.4	—
20. Krone	—	4.0	1.8	—	1.6	—	1.4	—	—	6.4	1.8	—
21. Lampe	—	2.0	—	7.4	1.2	—	1.0	..	—	2.8	1.2	—
22. Leiter	—	2.0	1.4	—	1.4	—	1.8	—	—	3.0	1.2	—
23. Lilie	—	2.2	—	17.6	1.4	—	—	2.4	—	5.2	—	2.2
24. Maske	—	2.6	1.8	—	1.6	—	1.4	—	—	3.2	1.8	—
25. Maus	—	2.2	—	7.0	1.4	—	1.2	—	—	4.0	1.4	—
26. Nase	—	(35.0)	—	(12.4)	—	2.0	1.4	—	—	(12.2)	—	4.0
27. Nest	—	6.4	—	(17.6)	—	10.0	1.6	—	—	5.6	—	6.4
28. Ofen	—	3.0	—	2.8	1.2	—	—	2.0	—	10.0	1.4	—
29. Rad	1.4	—	1.0	—	1.0	—	1.6	—	1.6	—	1.0	—
30. Ring	—	4.0	—	2.8	1.2	—	1.2	—	—	2.6	1.6	—
31. Rose	—	6.6	—	7.0	—	6.0	1.4	—	—	(16.4)	—	5.4
32. Schaf	1.8	—	—	2.4	1.4	—	1.6	—	—	5.8	1.6	—
33. Schlange	—	3.4	1.8	—	1.2	—	1.0	—	—	3.6	1.0	—
34. Schlitten	—	2.6	—	(12.2)	1.2	—	1.6	—	—	5.0	—	2.0
35. Schnecke	1.8	—	—	(16.8)	1.6	—	1.2	—	—	6.0	—	6.6
36. Schubkarren	—	2.4	1.8	—	1.2	—	1.4	—	—	6.6	1.4	—
37. Schwan	1.6	—	—	2.2	1.2	—	1.2	—	—	2.0	1.6	—
38. Sense	1.6	—	1.4	—	1.4	—	1.0	—	1.8	—	1.2	—
39. Spinne	—	3.0	—	2.8	—	4.6	—	2.2	—	4 8	—	3.4
40. Strumpf	1.8	—	1.0	—	1.0	—	1.4	—	1.8	—	1.4	—
41. Tasche	—	3.6	—	8.8	1.4	—	—	3.0	—	3.2	1.6	—
42. Traube	—	2.6	1.6	—	1.4	—	1.8	—	—	4.6	1.4	—
43. Treppe	—	4.4	—	(14.2)	1.0	—	—	2.4	—	4.6	1.6	—
44. Trommel	1.8	—	1.4	—	1.4	—	1.2	—	—	4.8	1.4	—
45. Truthahn	—	2.6	—	2.0	—	3.6	1.4	—	—	5.8	1.8	—
46. Vogel	—	4.8	—	10.0	1.8	—	1.4	—	—	5.4	1.4	—
47. Wiege	—	5.0	—	(15.0)	1.4	—	1.6	—	—	5.2	—	5.4
48. Windmühle	—	2.0	—	(19.2)	1.4	—	—	2.4	—	4.4	—	3.4
49. Wurst	—	5.2	—	(12.4)	—	2.0	1.6	—	—	6.4	—	3.4
50. Zither	—	2.2	—	3.0	1.4	—	1.0	—	—	2.0	1.4	—
Total	16.6	142.8	26.0	108.2	57.4	32.2	54.6	22.8	8.0	187.2	48.2	60.0
Average	3.3		3.4		1.8		1.6		4.2		2.2	
Correct	96%		80%		100%		100%		92%		100%	

Egelfin

	13/V		20/V		20/V		20/V		23/V		23/V	
	Steiger		Stossberger		Schremser		Uhrmann		Mehlstretter		Listle	
	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00
1. Auge	—	3.4	—	2.6	0.8	—	—	(8.2)	1.4	—	—	2.0
2. Bär	—	2.8	1.6	—	1.4	—	—	4.0	—	2.4	—	4.4
3. Baum	—	2.2	1.6	—	1.2	—	1.8	—	—	2.0	—	2.6
4. Bett	—	3.2	—	4.2	1.4	—	—	5.6	1.4	—	—	(19.0)
5. Bretzel	—	3.0	1.6	—	1.2	—	—	4.4	1.6	—	—	3.6
6. Brief	—	2.4	—	3.4	1.4	—	—	13.4		2.2	—	(7.4)
7. Bürste	—	9.2	1.6	—	1.0	—	1.8	—	1.8	—	—	6.0
8. Eichel	—	7.6	—	3.8	1.2	—	—	2.2	—	5.2	—	7.8
9. Ente	1.8	—	—	2.8	1.0	—	—	2.8	—	2.4	—	2.6
10. Esel	—	3.4	1.6	—	0.8	—	—	12.4	1.6	—	—	13.6
11. Eule	—	2.2	—	4.2	1.4	—	—	2.4	1.8	—	—	9.6
12. Fächer	1.8	—	—	2.8	1.2	—	—	5.6	1.6	—	—	3.6
13. Finger	—	4.4	—	3.6	1.2	—	—	3.2	—	29.8	—	4.4
14. Frosch	—	6.8	1.8	—	1.2	—	—	2.6	—	2.6	—	(13.4)
15. Hase	—	2.4	1.4	—	1.0	—	1.8	—	—	2.6	—	3.0
16. Kerze	—	3.4	—	12.4	1.6	—	—	(7.4)	—	2.6	—	6.0
17. Kette	—	2.8	—	2.0	1.0	—	—	11.6	1.4	—	—	(12.6)
18. Koffer	—	4.8	—	4.0	1.6	—	—	3.4	—	2.2	—	(6.2)
19. Krebs	—	2.8	—	9.4	1.2	—	—	2.8	—	6.2	—	6.4
20. Krone	—	2.6	—	2.0	1.0	—	—	12.2	—	2.6	—	8.8
21. Lampe	—	2.4	—	2.4	1.6	—	—	3.0	1.8	—	—	5.4
22. Leiter	1.8	—	—	2.4	1.2	—	—	2.8	—	2.4	—	2.0
23. Lilie	—	4.0	—	2.0	1.2	—	—	6.4	—	2.2	—	(9.2)
24. Maske	—	12.4	—	2.6	1.4	—	—	2.8	—	2.6	—	3.8
25. Maus	—	6.4	—	2.2	1.8	—	—	4.8	—	2.2	—	8.4
26. Nase	—	13.0	—	6.6	1.6	—	—	(11.0)		(42.0)	—	(12.0)
27. Nest	—	3.2	—	2.0	1.8	—	—	(16.4)		3.0	—	6.4
28. Ofen	—	2.4	—	2.0	1.2	—	—	8.8	1.4	—	—	8.4
29. Rad		2.6	1.4	—	1.0	—	1.6	—	—	2.4	—	2.2
30. Ring	1.4	—	1.8	—	1.4	—	—	4.4	—	2.0	—	6.8
31. Rose	—	7.4	—	20.2	1.4	—	—	10.6	—	2.0	—	12.6
32. Schaf	—	2.4	1.8	—	1.6	—	—	4.8	—	4.4	—	5.6
33. Schlange	—	6.2	1.4	—	1.0	—	—	2.0	1.6	—	—	5.4
34. Schlitten		7.4		28.0	1.4	—	—	(5.0)	—	5.2	—	(9.4)
35. Schnecke	—	4.2	—	4.0	1.6	—	—	(9.8)	—	4.6	—	17.0
36. Schubkarren	—	2.8	—	2.6	1.4	—	1.8	—	1.8	—	—	13.0
37. Schwan	—	3.4	1.8	—	1.6	—	—	2.0	1.6	—	—	2.6
38. Sense	—	3.4	1.8	—	1.0	—	1.4	—	—	2.0	1.2	—
39. Spinne	—	3.8	1.4	—	1.4	—	—	3.0	—	2.0	—	4.8
40. Strumpf	—	3.4	1.4	—	1.0	—	—	2.8	1.6	—	—	4.4
41. Tasche	—	5.0	—	2.0	1.8	—	—	3.4	—	2.4	—	6.2
42. Traube	—	8.2	1.8	—	1.4	—	—	2.6	—	5.8		(16.4)
43. Treppe	—	3.4	—	2.0	1.4	—	1.8	—	—	2.0	—	5.4
44. Trommel	—	3.6	—	4.6	1.0	—	—	4.2	—	2.4	—	4.6
45. Truthahn	—	4.0	—	2.8	1.6	—	—	2.4	—	6.8	—	(5.4)
46. Vogel	—	3.4	—	3.0	1.6	—	—	(8.0)	—	2.4	—	(8.6)
47. Wiege	—	6.4	—	4.8	1.4	—	—	12.6	—	5.2	—	(10.2)
48. Windmühle	—	3.4	—	3.8	1.2	—	—	4.6	—	3.2	—	3.4
49. Wurst	—	9.4	—	2.8	1.0	—	—	8.4	—	5.2	—	6.4
50. Zither	—	2.4	—	2.8	1.4	—	—	2.2	1.4	—	1.8	—
Total	6.8	209.4	25.8	162.8	65.2		12.0	187.2	23.8	135.2	3.0	219.2
Average	4.3		3.8		1.3		4.6		3.2		5.9	
Correct	100%		100%		100%		86%		98%		76%	

Egelfin

	30/V		30/V		6/VI		10/VI		13/VI		13/VI	
	Vetter		Gramminger		Rohr		Flechsel		A. Müller		Wahlrab	
	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2-0-00
1. Auge	1.4	—	1.0	—	1.4	—	1.4	—	1.4	—	0.8	—
2. Bär	1.6	—	1.2	—	—	13.0	1.8	—	—	2.8	—	6.0
3. Baum	1.6	—	1.2	—	1.6	—	1.8	—	1.6	—	1.0	—
4. Bett	—	(22.0)	1.4	—	—	2.2	—	2.4	—	7.6	1.2	—
5. Bretzel	1.4	—	1.4	—	1.4	—	—	2.0	1.8	—	—	2.4
6. Brief	1.6	—	1.2	—	1.4	—	1.8	—	1.0	—	1.6	—
7. Bürste	1.2	—	1.2	—	1.6	—	1.6	—	1.8	—	1.0	—
8. Eichel	—	2.0	1.4	—	—	9.8	—	3.0	—	4.8	—	3.0
9. Ente	—	2.0	1.6	—	1.8	—	1.6	—	—	2.8	—	2.0
10. Esel	1.4	—	1.2	—	—	2.0	1.6	—	1.8	—	1.6	—
11. Eule	—	2.0	1.2	—	—	3.8	1.2	—	—	2.2	1.2	—
12. Fächer	1.8	—	1.4	—	1.8	—	1.6	—	1.4	—	1.0	—
13. Finger	1.4	—	1.2	—	—	3.2	1.4	—	1.6	—	1.0	—
14. Frosch	1.8	—	1.4	—	1.6	—	1.6	—	1.8	—	1.2	—
15. Hase	1.4	—	1.0	—	—	2.0	1.2	—	1.6	—	1.4	—
16. Kerze	—	2.0	1.0	—	1.4	—	—	2.0	1.4	—	1.6	—
17. Kette	1.6	—	1.2	—	—	3.6	—	2.0	1.4	—	1.0	—
18. Koffer	1.8	—	1.2	—	1.8	—	—	2.4	—	2.2	0.8	—
19. Krebs	1.6	—	1.4	—	—	2.0	—	2.4	1.6	—	—	5.4
20. Krone	1.4	—	1.4	—	—	5.4	—	2.2	—	2.2	1.0	—
21. Lampe	1.6	—	1.4	—	1.4	—	1.2	—	1.4	—	0.8	—
22. Leiter	1.4	—	0.8	—	1.6	—	—	2.0	1.2	—	1.2	—
23. Lilie	—	2.6	1.4	—	—	3.6	1.8	—	—	3.0	1.4	—
24. Maske	1.8	—	1.4	—	—	2.0	1.4	—	—	2.2	1.2	—
25. Maus	1.4	—	1.4	—	—	2.4	1.4	—	—	2.0	1.6	—
26. Nase	—	(16.0)	—	2.0	—	(33.0)	—	2.0	—	20.	—	5.6
27. Nest	—	2.0	1.6	—	—	2.0	—	2.2	—	2.0	—	3.2
28. Ofen	—	2.4	1.0	—	—	2.2	1.8	—	1.6	—	1.4	—
29. Rad	1.4	—	1.0	—	1.4	—	—	3.0	1.2	—	1.4	—
30. Ring	1.4	—	1.4	—	1.6	—	1.8	—	1.6	—	1.0	—
31. Rose	—	2.0	1.2	—	—	2.0	—	2.6	—	2.0	1.8	—
32. Schaf	1.8	—	1.4	—	1.6	—	1.4	—	1.8	—	—	2.4
33. Schlange	1.4	—	1.2	—	—	13.0	1.6	—	1.4	—	1.0	—
34. Schlitten	—	2.4	1.4	—	—	(37.2)	—	2.0		2.6	1.4	—
35. Schnecke	—	4.8	1.4	—	—	3.4	1.4	—	1.8	—	—	2.2
36. Schubkarren	1.4	—	1.4	—	1.4	—	1.4	—	—	2.4	1.2	—
37. Schwan	1.4	—	1.0	—	—	12.4	1.4	—	1.0	—	1.2	—
38. Sense	1.2	—	1.0	—	—	2.6	1.8	—	1.4	—	1.4	—
39. Spinne	—	2.0	1.2	—	1.8	—	—	2.0	—	2.4	1.6	—
40. Strumpf	1.2	—	1.6	—	—	3.0	1.8	—	—	2.4	1.2	—
41. Tasche	1.8	—	1.8	—	1.4	—	—	2.0	—	2.6	1.4	—
42. Traube	1.6	—	1.4	—	—	2.4	1.4	—	1.2	—	1.0	—
43. Treppe	1.2	—	1.2	—	1.4	—	—	3.4	1.6	—	1.0	—
44. Trommel	1.4	—	1.0	—	1.8	—	1.2	—	1.6	—	1.2	—
45. Truthahn	1.4	—	1.4	—	—	2.0	—	2.2	1.8	—	1.4	—
46. Vogel	1.4	—	1.2	—	—	4.2	1.4	—	—	4.4	1.0	—
47. Wiege	—	2.4	1.2	—	1.6	—	—	3.0	—	4.4	1.8	—
48. Windmühle	1.8	—	—	2.0	—	2.0	1.6	—	1.4	—	1.4	—
49. Wurst	—	2.0		2.2	—	3.2	—	2.2	—	6.8	1.8	—
50. Zither	1.4	—	1.0	—	1.6	—	1.6	—	1.6	—	1.0	—
Total	52.4	30.6	59.6	6.2	34.4	109.4	46.0	47.0	43.8	83.8	51.2	32.2
Average	1.7		1.3		3.0		1.9		2.6		1.7	
Correct	96%		100%		96%		100%		100%		100%	

Haar

	27/VI		27/VI		1/VII		22/VII		15/VII		22/VII	
	S. Neumann		H. Bischoff		Wünschheim		Kammermaier		Gravatschky		Bolz	
	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00
1. Auge	1.4	—	1.6	—	1.2	—	—	4.6	1.2	—	1.2	—
2. Bär	—	6.8	—	2.0	1.4	—	—	8.8	1.8	—	1.4	—
3. Baum	1.0	—	1.6	—	1.4	—	—	14.0	1.6	—	1.6	—
4. Bett	—	4.6	—	6.0	1.4	—	—	10.2	1.8	—	—	4.2
5. Bretzel	—	2.4	1.6	—	—	3.6	—	6.8	1.4	—	1.8	—
6. Brief	1.4	—	1.4	—	1.6	—	—	(11.6)	1.8	—	1.6	—
7. Bürste	—	3.0	1.6	—	1.4	—	—	(8.8)	1.4	—	1.4	—
8. Eichel	1.6	—	—	2.4	1.8	—	—	4.4	—	2.6	—	2.4
9. Ente	1.8	—	—	2.0	1.2	—	—	7.0	—	2.0	1.4	—
10. Esel	1.6	—	1.4	—	1.2	—	—	4.6	1.8	—	1.2	—
11. Eule	1.6	—	—	2.4	1.4	—	—	7.0	1.4	—	1.2	—
12. Fächer	1.4	—	1.6	—	1.4	—	—	8.6	1.2	—	1.2	—
13. Finger	1.8	—	—	4.0	1.6	—	—	(10.4)	1.6	—	1.4	—
14. Frosch	1.8	—	1.8	—	—	2.0	—	27.2	1.8	—	1.2	—
15. Hase	—	2.2	—	2.0	1.4	—	—	13.6	1.6	—	1.4	—
16. Kerze	—	10.8	1.4	—	1.8	—	—	(8.8)	1.4	—	1.6	—
17. Kette	—	2.6	—	3.0	1.4	—	—	(5.0)	1.4	—	1.2	—
18. Koffer	1.4	—	—	11.0	1.8	—	—	(7.4)	1.8	—	1.2	—
19. Krebs	1.6	—	1.6	—	—	2.2	—	12.2	1.4	—	1.4	—
20. Krone	—	2.4	1.8	—	1.4	—	—	(11.4)	1.4	—	1.4	—
21. Lampe	1.0	—	1.4	—	1.4	—	—	6.0	1.2	—	1.4	—
22. Leiter	1.2	—	1.2	—	1.6	—	—	12.6	1.8	—	1.4	—
23. Lilie	—	4.2	—	2.6	—	3.0	—	14.2	1.6	—	1.6	—
24. Maske	1.6	—	—	2.6	1.4	—	—	12.2	1.8	—	1.4	—
25. Maus	—	3.0	—	2.4	1.6	—	—	(10.2)	1.6	—	1.4	—
26. Nase	—	5.8	1.8	—	—	17.4	—	8.2	—	2.6	1.6	—
27. Nest	—	15.4	—	4.6	—	4.2	—	12.0	1.8	—	1.8	—
28. Ofen	—	3.0	—	3.0	—	3.2	—	(4.6)	1.4	—	1.6	—
29. Rad	1.0	—	1.4	—	1.2	—	—	17.2	1.4	—	1.4	—
30. Ring	—	2.4	—	2.6	1.4	—	—	7.6	1.4	—	1.4	—
31. Rose	—	5.0	1.8	—	—	2.2	—	16.4	—	2.4	1.4	—
32. Schaf	1.4	—	—	2.0	1.4	—	—	10.2	1.4	—	1.8	—
33. Schlange	1.8	—	1.4	—	1.4	—	—	18.6	1.4	—	1.4	—
34. Schlitten	—	12.0	1.8	—	—	2.0	—	(6.8)	1.6	—	1.8	—
35. Schnecke	—	5.4	1.6	—	—	3.6	—	(12.0)	1.6	—	1.4	—
36. Schubkarren	—	2.8	—	2.2	1.4	—	—	8.6	—	2.0	1.2	—
37. Schwan	—	2.0	1.8	—	1.4	—	—	13.0	1.0	—	1.8	—
38. Sense	—	2.4	1.6	—	—	2.0	—	11.2	1.6	—	1.0	—
39. Spinne	—	2.4	1.4	—	1.6	—	—	8.0	1.6	—	1.4	—
40. Strumpf	1.4	—	—	2.0	—	4.4	—	18.2	1.8	—	1.4	—
41. Tasche	—	2.8	—	4.0	1.8	—	—	10.0	1.8	—	1.4	—
42. Traube	1.6	—	—	2.0	—	4.0	—	20.6	1.4	—	1.2	—
43. Treppe	1.4	—	—	2.0	—	2.8	—	(16.2)	1.6	—	1.2	—
44. Trommel	1.4	—	1.4	—	—	2.2	—	(5.0)	1.4	—	1.4	—
45. Truthahn	1.8	—	1.8	—	1.4	—	—	(10.8)	1.8	—	1.4	—
46. Vogel	—	3.0	1.6	—	1.6	—	—	(10.2)	1.6	—	1.4	—
47. Wiege	—	3.8	—	3.8	—	3.4	—	4.8	1.8	—	—	2.0
48. Windmühle	—	8.6	1.8	—	—	2.0	—	4.8	1.8	—	1.4	—
49. Wurst	—	2.2	—	3.6	—	3.6	—	(12.8)	—	3.6	1.6	—
50. Zither	1.8	—	1.4	—	1.4	—	—	16.4	1.4	—	1.0	—
Total	35.8	121.0	42.6	74.2	46.8	67.8		379.8	68.4	15.2	66.4	8.6
Average	3.1		2.3		2.3		11.2		1.7		1.5	
Correct	100%		100%		100%		68%		100%		100%	

	Total	Average	Incorrect
1. Auge	43.2	1.5	3%
2. Bär	95.0	3.2	—
3. Baum	63.6	2.1	—
4. Bett	81.2	3.1	13%
5. Bretzel	64.6	2.2	—
6. Brief	53.4	2.0	10%
7. Bürste	61.8	2.1	3%
8. Eichel	97.6	3.3	—
9. Ente	63.2	2.1	—
10. Esel	82.0	2.7	—
11. Eule	76.4	2.5	—
12. Fächer	62.2	2.1	—
13. Finger	95.8	3.5	10%
14. Frosch	83.0	2.9	3%
15. Hase	62.0	2.1	—
16. Kerze	110.2	4.1	10%
17. Kette	67.6	2.4	7%
18. Koffer	79.2	2.9	10%
19. Krebs	89.2	3.0	—
20. Krone	88.8	3.1	3%
21. Lampe	57.2	1.9	—
22. Leiter	60.2	2.0	—
23. Lilie	110.2	3.8	3%
24. Maske	79.6	2.7	—
25. Maus	75.8	2.6	3%
26. Nase	113.0	5.4	30%
27. Nest	110.2	4.1	10%
28. Ofen	74.8	2.6	3%
29. Rad	57.4	1.9	—
30. Ring	68.8	2.3	—
31. Rose	140.8	5.0	7%
32. Schaf	78.8	2.6	—
33. Schlange	85.8	2.9	—
34. Schlitten	98.0	3.9	17%
35. Schnecke	87.4	3.2	10%
35. Schubkarren	92.6	3.1	—
37. Schwan	71.4	2.4	—
38. Sense	64.2	2.1	—
39. Spinne	82.5	2.8	—
40. Strumpf	75.0	2.5	—
41. Tasche	87.6	2.9	—
42. Traube	83.6	3.0	7%
43. Treppe	60.4	2.2	7%
44. Trommel	56.4	1.9	3%
45. Truthahn	80.4	2.9	7%
46. Vogel	68.0	2.5	10%
47. Wiege	97.8	3.5	7%
48. Windmühle	90.0	3.1	3%
49. Wurst	98.8	3.5	7%
50. Zither	64.4	2.1	—
Grand Total	3991.1	140.3	206
Average	79.8	2.9	4%

B. NORMAL SUBJECTS.

JOSEPH BLIEM.* SCHLOSSER. 20 years old.

Date	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
VII/17	7	38	7	52	6	28	5	19	5	43	4	22	5	14	2	18
	6	24	4	38	3	13	2	11	4	33	3	14	5	17	4	29
VII/30	6	27	5	41	6	42	6	41	5	23	4	41	4	14	3	7
	7	43	6	68	4	24	5	35	7	28	6	31	6	13	5	16
Total	26	132	22	199	19	107	18	106	21	127	17	108	20	58	14	70
SZ/M		5.1		9.0		5.6		5.9		6.0		6.4		2.9		5.0

Nothing mentioned that was not present.

* Potus. Since coming to Munich, only three days ago, has been drinking three half liters of beer daily. Previously, in Austria, he drank only two or three half liters a week.

Things named immediately..... 86

Things named after 1 minute..... 71

$$\text{Ratio } \frac{71}{86} = .867.$$

MAX HERZ.* SCHREINER. 27 years old.

Date	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
VII/29	5	37	6	34	5	28	6	24	5	42	4	29	5	19	4	39
	4	29	4	23	5	34	3	17	6	31	4	25	5	21	5	59
	7	44	5	21	5	23	5	24	6	22	6	32	6	18	4	14
	6	32	4	33	4	18	4	118	4	21	3	28	5	15	5	17
Total	22	142	19	111	19	103	18	183	21	116	17	114	21	73	18	129
SZ/M		6.5		5.8		5.4		10.2		5.5		6.7		3.5		7.2

* Potus. Drinks beer only on Sundays, and then about three half liters.

Things named immediately..... 83

Things named after 1 minute..... 72

$$\text{Ratio } \frac{72}{83} = .876.$$

HEINRICH SPAID. FRISEUR. 19½ years old.

Date	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
17/VII	6	23	7	34	7	28	5	11	5	24	4	16	5	16	3	17
	7	22	7	22	7	29	6	17	5	18	5	19	4	11	4	28
Total	13	45	14	56	14	57	11	28	10	42	9	35	9	27	7	45
SZ/M		3.5		4.0		4.1		2.5		4.2		3.9		3.0		6.4

Nothing mentioned which was not present.
*Potus: One liter of beer every day.
Things named immediately..... 46
Things named after 1 minute..... 41

Ratio $\frac{41}{46} = .891.$

JOHANN BAPTIST SCHENCK.* SCHNEIDER. 19 years old.

Date	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
17/VII	8	42	8	52	6	25	6	27	7	43	4	19	6	26	5	13
	7	38	8	30	6	40	6	34	6	30	5	21	5	17	4	13
	5	18	5	14	7	20	6	32	7	23	6	16	6	29	6	34
	7	24	7	86	6	37	5	20	6	31	5	20	7	52	8	64
Total	27	122	28	182	25	122	23	113	26	127	20	76	24	124	23	124
SZ/M		4.5		6.5		4.9		4.9		4.9		3.8		5.2		5.4

Things mentioned that were not present: Kamm.
*Total abstainer.
Things named immediately.....102
Things named after 1 minute..... 94

Ratio $\frac{94}{102} = .921.$

HERMANN SCHEIBENPFLUG.* SCHREINER. 19½ years old.

Date	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
VII/17	5	18	4	21	7	32	7	29	4	44	4	12	4	9	2	8
	5	29	5	27	5	29	5	39	6	16	3	18	5	44	3	9
Total	10	47	9	48	12	61	12	68	10	60	7	30	9	53	5	17
SZ/M		4.7		5.3		5.1		5.7		6.0		4.3		5.9		3.4

Nothing mentioned that was not present.

* Potus. One liter of beer at most in a day, but often drinks none at all.

Things named immediately..... 41

Things named after 1 minute..... 33

Ratio $\frac{33}{41} = .805$.

GUSTAV WORSCH.* BUCHBINDER. 20 years old.

Date	OBJECTS				PICTURES				PRINTED WORDS				SPOKEN WORDS			
	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z	M	Z
17/VII	5	34	6	34	6	24	5	19	6	39	5	19	5	23	3	13
	8	51	7	31	6	23	3	14	5	39	2	24	4	12	2	20
Total	13	85	13	65	12	47	8	33	11	78	7	43	9	35	5	33
SZ/M		6.5		5.0		3.9		4.1		7.1		6.1		3.9		6.6

Things mentioned that were not present: Schuh.

* Potus: Every second or third day one liter of beer.

Things named immediately..... 45

Things named after 1 minute..... 33

Ratio $\frac{33}{45} = .733$.

TABLE OF AVERAGES. NORMAL SUBJECTS

	Immediate		1 minute		Immediate		1 minute		Immediate		1 minute		Immediate		1 minute	
	M	Z/M	M	Z/M	M	Z/M	M	Z/M	M	Z/M	M	Z/M	M	Z/M	M	Z/M
J. B.	26	5.1	22	9.0	19	5.6	18	5.9	21	6.0	17	6.4	20	2.9	14	5.0
M. H.	22	6.5	19	5.8	19	5.4	18	10.2	21	5.5	17	6.7	21	3.5	18	7.2
H. S.*	20	4.7	18	5.3	24	5.1	24	5.7	20	6.0	14	4.3	18	5.9	10	3.4
J. B. S.	27	4.5	28	6.5	25	4.9	23	4.9	26	4.9	20	3.8	24	5.2	23	5.4
H. S.*	26	3.5	28	4.0	28	4.1	22	2.5	20	4.2	18	3.9	18	3.0	14	6.4
G. W.*	26	6.5	26	5.0	24	3.9	16	4.1	22	7.1	14	6.1	18	3.9	10	6.6
Subject																

* This subject made only two series. His memory averages were doubled to make them comparable with the four of the other subjects.

Normal Subjects

	30/VI		17/VII		20/VII		17/VII	
	Bliem		Schenck		Herz		Spaid*	
	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00	0–1.8	2.0-00
1. Auge	0.8	—	1.0	—	1.4	—	1.0	—
2. Bär	1.2	—	0.8	—		2.2	1.0	—
3. Baum	1.0	—	0.8	—	1.4	—	1.6	—
4. Bett	1.8	—	1.0	—		2.0	1.6	—
5. Bretzel	1.4	—	1.0	—	1.4	—	1.4	—
6. Brief	1.2	—	0.8	—		2.2	1.0	—
7. Bürste	1.2	—	0.8	—	1.0	—	1.2	—
8. Eichel	—	2.0	1.0	—	1.6	—	—	2.0
9. Ente	1.6	—	0.6	—	1.2	—	1.4	—
10. Esel	1.0	—	1.0	—	1.6	—	1.0	—
11. Eule	1.2	—	0.8	—	1.4	—	1.2	—
12. Fächer	1.6	—	0.4	—	—	2.4	1.0	—
13. Finger	1.0	—	0.8	—	1.0	—	1.0	—
14. Frosch	1.2	—	1.0	—	—	2.0	1.0	—
15. Hase	1.0	—	0.6	—	1.0	—	1.2	—
16. Kerze	1.2	—	1.0	—	—	2.4	0.8	—
17. Kette	1.2	—	0.8	—	1.0	—	—	—
18. Koffer	1.0	—	0.8	—	1.4	—	—	—
19. Krebs	1.2	—	1.0	—	1.4	—	—	—
20. Krone	1.6	—	0.8	—	1.6	—	1.0	—
21. Lampe	1.0	—	0.6	—	1.2	—	0.8	—
22. Leiter	1.4	—	0.4	—	1.4	—	1.0	—
23. Lilie	1.6	—	0.6	—	1.2	—	1.0	—
24. Maske	1.2	—	0.6	—	—	2.6	1.0	—
25. Maus	1.0	—	0.8	—	1.4	—	—	—
26. Nase	—	(19.0)	1.8	—	1.6	—	—	8.6
27. Nest	1.4	—	0.8	—	1.8	—	1.4	—
28. Ofen	1.2	—	0.8	—	1.2	—	1.0	—
29. Rad	0.6	—	1.0	—	1.2	—	1.0	—
30. Ring	1.0	—	0.4	—	1.6	—	1.2	—
31. Rose	1.2	—	0.8	—	1.0	—	0.8	—
32. Schaf	1.2	—	0.6	—	—	3.6	—	—
33. Schlange	1.0	—	1.0	—	1.4	—	1.0	—
34. Schlitten	1.4	—	0.8	—	1.4	—	—	2.2
35. Schnecke	1.6	—	1.4	—	—	2.0	1.4	—
36. Schubkarren	1.2	—	1.0	—	1.6	—	1.4	—
37. Schwan	1.0	—	0.8	—	1.6	—	1.2	—
38. Sense	0.8	—	0.8	—	1.2	—	0.8	—
39. Spinne	—	2.0	0.8	—	1.4	—	—	—
40. Strumpf	0.8	—	0.8	—	—	2.2	—	—
41. Tasche	1.0	—	0.6	—	1.0	—	1.2	—
42. Traube	1.4	—	—	2.4	1.4	—	1.2	—
43. Treppe	1.0	—	0.8	—	1.4	—	1.4	—
44. Trommel	1.0	—	0.8	—	1.4	—	—	—
45. Truthahn	1.8	—	1.0	—	1.6	—	1.6	—
46. Vogel	1.0	—	1.0	—	1.4	—	0.8	—
47. Wiege	—	2.0	1.4	—	1.4	—	1.2	—
48. Windmühl	—	4.8	1.0	—	1.4	—	1.0	—
49. Wurst	1.6	—	1.0	—	—	2.2	1.0	—
50. Zither	1.0	—	1.0	—	1.2	—	1.0	—
Total	53.8	10.8	42.0	2.4	52.8	25.8	43.8	12.8
Average	1.3		0.9		1.6		1.4	
Correct	98%		100%		100%		84%	

* Experiment had to be interrupted and 8 reactions were not taken with this subject.

CHAPTER III

CORRELATIONS

Using the Bravais-Pearson Coefficient of correlation I have worked out the following table of correlations. The heavy-faced figures indicate the correlations, those in italics the probable errors.

This formula holds only in case of linear regression.[3] If the regression is non-linear it gives values which may be much too low. As a check I have calculated for three sets of values Pearson's correlation ratio η. The values obtained were as follows: Immediate memory and perception $\eta = 0.68$ and 0.62; Memory Ratio and perception $\eta = 0.65$; Memory ratio and immediate memory $\eta = 0.65$ and 0.71. I reproduce the calculations of one of these because the method is not generally familiar and because it gives some idea of the distribution of values and enables us with one glance to get information on the point whether or not the disturbances of memory and perception go hand in hand, or whether the one is disturbed at times out of all proportion to the other.

We find, on glancing at the distribution table, that the subjects producing the most disturbance are Uhrmann, Mehlstretter, Bach and Schremser. Uhrmann and Mehlstretter are out of place, because their powers of perception are affected out of all proportion to their powers of memory. Bach and Schremser, on the other hand, are out of place because their immediate memory is weakened out of all proportion to their powers of perception. Thus the problem raised in the introduction is answered at once from a glance at this table. There is a general tendency for both functions to deteriorate together, but one of them may be affected without the other. Similarly with the other correlations. The rather high correlation indicates the

[3] Cf. hereon Wm. Brown. The Essentials of Mental Measurement. Cambridge, 1911. Chapter I.

[4] Cf. hereon Karl Pearson. On the General Theory of Skew Correlation and Non-linear Regression. Drapers' Company Research Memoirs. Biometric Series II, xiv. Also Brown, op. cit., P 57 ff.

	Memory Immediate, Objects	Memory Immediate, Pictures	Memory Immediate, Printed Words	Memory Immediate, Spoken Words	Memory Ratio, Objects	Memory Ratio, Pictures	Memory Ratio, Printed Words	Memory Ratio, Spoken Words	Total Immediate Memory	General Memory Ratio	Perception
Memory Immediate, Objects,		.75	.66	.55	.68	.71	.51	.60	.85	.76	.62
Memory Immediate, Pictures,	.75 .05		.76	.52	.57	.58	.43	.66	.90	.68	.67
Memory Immediate, Printed Words,	.66 .07	.76 .05		.68	.48	.36	.41	.61	.86	.49	.54
Memory Immediate, Spoken Words,	.55 .09	.52 .09	.68 .07		.36	.23	.19	.58	.79	.33	.39
Memory Ratio, Objects,	.68 .07	.57 .08	.48 .09	.36 .11		.79	.58	.62	.56	.90	.61
Memory Ratio, Pictures,	.71 .06	.58 .08	.36 .11	.23 .12	.79 .05		.53	.61	.53	.92	.54
Memory Ratio, Printed Words,	.51 .09	.43 .10	.41 .10	.19 .12	.58 .08	.53 .09		.67	.41	.72	.37
Memory Ratio, Spoken Words,	.60 .08	.66 .07.	.61 .08	.58 .08	.62 .08	.61 .08	.67 .07		.69	.78	.46
Total Immediate Memory,	.85 .03	.90 .02	.86 .03	.79 .05	.56 .08	.53 .09	.41 .10	.69 .07		.68	.65
General Memory Ratio,	.76 .05	.68 .07	.49 .09	.33 .11	.90 .02	.92 .02	.72 .06	.78 .05	.68 .07		.58
Perception,	.62 .08	.67 .07	.54 .09	.39 .10	.61 .08	.54 .09	.37 .11	.46 .10	.65 .07	.58 .08	

CORRELATION RATIO BETWEEN IMMEDIATE MEMORY AND PERCEPTION.

Immed. memory = x.

	0-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	Totals n_y	Means $\bar{x}_y$
701-800				Schr. 60-769				Gram. 96-.758	2	78
601-700			Bach 50-.617		Web. 64.667	Aid. 75-.690 Bolz 80-.667	Lang 86-.694		5	71
501-600				Seuf. 55-559 Vett. 52-.555	Flech. 62-.538		Grav. 88-.599 Wahl. 83-.593		5	68
401-500				Bauer. 57.463 Bisch. 58-.427	Wall. 61-.465 Wün. 66-.437				4	60.5
301-400			Rohr. 41-.320	Kraus 57-.337 Muller 53-.392	Neum. 65-.318		Mehl. 86-.302		5	60.4
201-300		Russ 31-.238 Ziss 40-.217	Wax. 49-.289	Biss. 51-.228 Stoss. 57-.265 Steiger 60-.231					6	48
Perceltion = y 0-200	Kamm. 19-.061		Listle 44-.130		Uhr. 63-.186				3	42
Totals (n_x)	1	2	4	10	6	2	4	1	N = 30	
Means $\bar{y}_x$	.061	.227	.339	.423	.435	.678	.547	.758		

tendency of both functions to deteriorate together. The fact that it is not higher is due to disturbing cases in which the deterioration in one function is relatively greater than in the other. Reference to the values of normal subjects in the preceding monographs on Memory and Perception will show that the low values of these subjects are distinctly pathological.

$$\eta^2 = \frac{\Sigma\left\{n_x\left(\bar{y}_x - \bar{y}\right)^2\right\}}{N\sigma_y^2} = \frac{.537267}{1.154686} = .46 \quad \eta = .68$$

$$\text{P.E.} = .67449\frac{1-\eta^2}{\sqrt{N}} = .67449\frac{1-.46}{5.4772} = .67449\frac{.54}{5.4772}$$

$$= .67449 \times .09 = .061$$

$\left(\bar{y}_x - y\right)$	$n_x\left(\bar{y}_x - \bar{y}\right)^2$
.061 − .434 = − .373	1 × .139129 = .139129
.227 − .434 = − .207	2 × .042829 = .085698
.339 − .434 = − .095	4 × .009025 = .036100
.423 − .434 = − .011	10 × .000121 = .001210
.435 − .434 = .001	6 × .000001 = .000006
.678 − .434 = .244	2 × .059536 = .119072
.547 − .434 = .113	4 × .012769 = .051076
.758 − .434 = .324	1 × .104976 = .104976
$\bar{y}$ = .434	$\Sigma\left\{n_x\left(\bar{y}_x - \bar{y}\right)^2\right\}$ = .537267
$N\sigma_y^2$ = 1.154686	

$$\eta^2 = \frac{\Sigma\left\{n_y\left(\bar{x}_y - \bar{x}\right)^2\right\}}{N\sigma_x^2} = \frac{3408.1}{8684.30} = .39 \quad \eta = .62$$

$$\text{P.E.} = .67449\frac{1-\eta^2}{\sqrt{N}} = .67449\frac{1-.39}{5.4772} = .67449\frac{.61}{5.4772}$$

$$= .67449 \times .11 = .074$$

$\left(\bar{x}_y - \bar{x}\right)$	$n_y\left(\bar{x}_y - \bar{x}\right)^2$
42. − 60.3 = − 18.3	3 × 334.89 = 1004.67
48. − 60.3 = − 12.3	6 × 151.29 = 907.74
60.4 − 60.3 = .1	5 × 000.01 = 000.05
60.5 − 60.3 = .2	4 × 000.04 = 000.16
68.0 − 60.3 = 7.7	5 × 059.29 = 296.45
71.0 − 60.3 = 10.7	5 × 114.49 = 572.45
78.0 − 60.3 = 17.7	2 × 313.29 = 626.58
$\bar{x}$ = 60.3	$\Sigma\left\{n_y\left(\bar{x}_y - \bar{x}\right)^2\right\}$ = 3408.10
$N\sigma^2_x$ = 8684.30	

Either the center theory or the whole cortex theory could account for this fact—in the absence of further information about the cortical condition of cases so far displaced from the mid line.

The center theory could say, in diffuse cortical degeneration certain areas are more affected than others. Occasionally one center remains free while the other is rather seriously affected; but as a rule a diffuse degeneration affects the whole cortex to about the same degree. We can see how very important would be autopsies on cases studied in this way who happened to die from pneumonia, accident, or other intercurrent affection. If the patient's mental functions were unequally deteriorated, the process of cortical degeneration, according to the center theory, should leave regions or islands more or less free. If such islands were found always associated with definite unimpaired functions, then the theory would be very strongly confirmed.

The whole cortex theory, on the other hand, would explain the present facts by saying that the cortex is more or less of a unit organ with many functions. These functions tend to deteriorate together, but owing to the selective action of toxines and variability of resistance and the presence perhaps of antibodies one function may at one time be relatively intact while another is seriously disturbed. Should autopsies on such cases dying from intercurrent affections show a generally diffuse degeneration with no free islands, or at least no free islands at always one and the same place for one and the same disturbance of function, then we would have to conclude that mental faculties are associated not with definite convolutions, but with specific cortical functions.

CHAPTER IV

Mental Faculties

The existence of mental faculties was assumed by many of the older psychologists. But with the critical attitude which appeared at the advent of empirical psychology and the concomitant interest in the measurement of special performances, and the gen-

eral impulse to question and deny traditional theories, it became customary to treat the old time "faculty psychology" with contempt—a contempt which, perhaps, was not altogether undeserved. For no one will deny that gratuitous statements about training the "faculties," unanalyzed concepts as to their specific unitary entity, gratuitous assumptions as to their operation, their interdependence, and mutual exclusiveness are unworthy of empirical psychology. At the same time, we should be careful not to deny, when we have ground only for doubts and it is our duty to correct and purify a view which, while it contains much that is false, has nevertheless some elements of truth.

Many of the early criticisms of the faculty psychology went to extremes wholly unwarranted by the existing facts. Only with the advent of experiment has it been possible to approach this problem with some hope of definitely extending our information concerning this field of thought. Curiously enough, experiment led at first to two diametrically opposed conclusions.

Thorndike, who was first in the field,[1] reached the conclusion that we have an indefinite number of mental abilities—as many, indeed, as there are performances. In an answer to Spearman he expressed himself in the following extreme words: "One is almost tempted to replace Spearman's statement by the equally extravagant one that there is *nothing whatever* common to all mental functions, or to any half of them."[2] In general, it seems to have been Thorndike's opinion that abilities are special, and when excellence in one is correlated with excellence in another this is due mainly to the fact that they involve identical elements in their execution and not to one and the same "faculty" which presides over their activity.

Spearman advocated, on the basis of his experiments, precisely

[1] Cf. Burris, W. P. *The Correlations of the Abilities Involved in Secondary School Work.* Columbia Univ. Contributions to Philosophy, Psychology and Education, Vol. 11, No. 2, Pp. 16-28. Thorndike, E. L. *Heredity Correlations and Sex Differences in School Abilities.* Loc. cit.

[2] *The Relation of Accuracy in Sensory Discrimination to General Intelligence,* by Thorndike, Lay and Dean. American Journal of Psychology, 1909, XX, Pp. 364-369.

the opposite view.[3] Mental abilities are correlated with each other mainly on account of one underlying faculty of general intelligence. This was done on the basis of new methods which he brought out for the correction of "Systematic Deviations."[4] After applying his methods of correction he found, e.g., that the correlation between sensory discrimination and intelligence approached unity, and concluded that "the common and essential element in the intelligences wholly coincides with the common and essential element in the Sensory Functions."[5]

Furthermore, if there are two factors in all performances, one a general factor and the other a special one, then

$$\frac{r\ (A,\ P)}{r\ (B,\ P)} = \frac{r\ (A,\ Q)}{r\ (B,\ Q)}$$

Where A, B, P, Q represent any four capacities not obviously akin and r means the correlation between the abilities in brackets.[6]

In virtue of this theorem, starting with one ability and arranging its correlation with the other abilities in their order of magnitude, the resulting table of correlations should have all its horizontal and vertical lines arranged in progressively diminishing rows. Spearmann and also Cyril Burt[7] found that this was actually the case within the limits of experimental error. William Brown,[8] on the other hand, with other groups of tests, maintained that not one of his groups showed the hierarchical arrangement. But his statement does not seem to be in accord with the facts. One is really surprised that the hierarchical arrangement is so closely approached.

But here the method seemed to be weak. If two observers

[3] *General Intelligence Objectively Determined and Measured.* American Journal of Psychology, 1904, XV, Pp. 201-293.

[4] Cf. *The Proof and Measurement of Association between Two Things.* American Journal of Psychology, 1904, XV, Pp. 72-101.

[5] l. c., P. 269.

[6] Cf. Cyril Burt. Experimental Tests of General Intelligence. *British Journal of Psychology,* 1909-10, Vol. III, P. 159.

[7] l. c.

[8] Some Experimental Results in the Correlation of Mental Abilities. *British Journal of Psychology,* 1909-1910, III, Pp. 296-322.

can dispute about whether or not the hierarchy is present we need an improved method to dispel their differences.

This Hart and Spearman accomplished in 1912.[9] Suppose, for instance, they say, we have several tests for three different faculties. Then the correlation between the tests for one and the same faculty should be naturally high, between one faculty and another relatively low. When we arrange, therefore, the tests in a table we should get—if indeed the three faculties really do exist and the tests measure them—a table similar to the following. Here *h* means a relatively high correlation, *l* a relatively low one.

	S_1	S_2	S_3	A_1	A_2	A_3	D_1	D_2	D_3
S_1		h	h	l	l	l	l	l	l
S_2	h		h	l	l	l	l	l	l
S_3	h	h		l	l	l	l	l	l
A_1	l	l	l		h	h	l	l	l
A_2	l	l	l	h		h	l	l	l
A_3	l	l	l	h	h		l	l	l
D_1	l	l	l	l	l	l		h	h
D_2	l	l	l	l	l	l	h		h
D_3	l	l	l	l	l	l	h	h	

We may now correlate the columns of correlation coefficients. This is the essential point in the improved method.

Supposing, in the first place, the faculty theory to hold, according as we pick out columns belonging to the same or different faculties we get high, low or negative correlations between the columns. Hart and Spearman speak only of high positive correlations and of negative correlations. But inspection seems to indicate three possibilities.

In the second place, let us suppose that there are no faculties, but only an indefinite number of abilities, then there will be no tendency anywhere for high and low values to come together, but they will be distributed by chance throughout the whole table. Thus all correlations between columns will be low.

[9] General Ability, Its Existence and Nature. *British Journal of Psychology*, 1912-1913, V, Pp. 51-84.

If we make the third possible supposition, that there is such a thing as general intelligence—and this is the main factor underlying all performances—then it will operate under varying difficulties with different tests, but in any column or row it will always enter as a constant factor, and so the resultant correlation between any two columns whatsoever will be high. Spearman offers a mathematical proof that this will be the case. In order that any pair of columns shall obey this law, it is necessary that the correlations should be relatively large and their deviations from the mean appreciable; otherwise their true values would be swamped by their sampling errors. He used as a criterion of reliability the requisition that the mean square probable error of the coefficients in any column should not be greater than a quarter of the mean square deviation of those coefficients.[10]

Applying a formula of correction for which the reader will have to consult the original, and taking the published results of observers of all schools, Spearman finds that the average correlation of columns is 0.96, that is, about unity, or practically perfect correlation. He has thus demonstrated the existence of a general factor; for no matter what one may say about his formula of correlation, even the uncorrelated or raw correlation of columns is so high that it excludes the possibility of chance and rules out the view that the mind is an aggregate of special abilities, with no underlying "general intelligence" or whatever the common factor may be called. Spearman does not regard the results as excluding special abilities and adopts what he terms the theory of two factors—one being a factor having to do with the cortex as a whole, the other being connected with the special centers.

One may ask, why does not the evidence appear more favorable for special faculties or functions, if such exist. One possible explanation is that the tests which have been used may not be tests of the special functions they were supposed to measure,

[10] l. c., P. 56. I find it difficult to see precisely what he has in mind by this criterion as he formulates it.

or at least that they involved such a large element of general intelligence that as a rule the common factor was measured rather than the specific. There is room at least for further experiment on this point. One should determine empirically the tests for specific functions by choosing from a large number of tests supposed to measure one special ability those that correlate high with each other. In this way we might find tests which really are measures of specific functions. If, then, we should apply the criterion of Hart and Spearman to these tests, one might find evidence of the existence of faculties as demanded by their theory.[11]

As a matter of fact, after having made out the above table of correlations for immediate memory, memory ratio and perception, I was surprised to find clear evidence for a difference between immediate memory and memory ratio—a difference which has long been recognized by Kraepelin,[12] and one which I had been always inclined to doubt. At the outset of these experiments I regarded the measurements of immediate memory and memory ratio as but the measurement of the subject's memory at two different stages and not, as it seems to be, the gauging of his ability to apprehend on the one hand and of his tendency to forget on the other. Inspection of the table of correlations[13] will show that the values are distributed as Hart and Spearman demand for tests of special function.

Thus, if you take from the table all those correlations in which one immediate memory is correlated with another, and add them up, you get an average correlation of .65 ⅓. If you take all those in which one memory ratio is correlated with another you get approximately the same value, 63 ⅓. If, however, you take all the correlations of the immediate memories with the memory ratios you get a much lower value, namely, .49 ¾.

Again, if you follow the horizontal line of correlations of total immediate memory you find the correlations high as long as they are correlations of total immediate memories. They im-

[11] Experiments along this line are now in progress at this laboratory.

[12] His pupil Finzi attributes the term *Merkfähigkeit* to Wernicke. Psychologische Arbeiten (Kraepelin, III, p. 291).

[13] See P. 332 above.

mediately become very decidedly lower when we come to the special memory ratios.

Inversely, when we follow the line of General Memory Ratio we find the correlations low with immediate memories, but high with special memory ratios.

The average of all the correlations of perception with the various memories is 53.8, a value fairly close to the above value for heterologous correlations. That the average correlation for memory and perception is as high as 53.8 shows that there must be a common factor present. But its presence does not exclude the existence of special forms of mental ability.

When now we come to correlate the columns of coefficients we can get high, low, or negative coefficients according as we select the columns. Thus, the correlation between the first and second columns, that namely between immediate memory for objects and immediate memory for pictures is + 0.82. The correlations between the columns for total immediate memory and general memory ratio is — 0.46. The correlation between the perception and general memory ratio columns is + 0.23.

Thus we see that under certain conditions at least the evidence for the existence of special abilities or faculties may be brought out by the criterion of Hart and Spearman.

We may ask why is this the case? The reason is probably to be sought in the fact that the memory ratio and immediate memory tests are so specific that the individual element is by no means negligible when compared to the general. This is a matter which can only be found by actual trial. Everything that glitters is not gold, and every test which on the surface appears to measure a subject's ability to associate, to remember, to attend, etc., may fall very far short of our expectations.

The problem of the existence of mental faculties needs to be taken up anew. Spearman has in various ways shown that the existence of a general factor is beyond all reasonable doubt. Further advance in this most interesting psychological field is to be made in the attempt to find out how many special factors there are and what is their nature. Definite and certain knowledge on these points would be of incomparable value.

The present paper has pointed out two special factors. The one is whatever special ability is involved in immediate memory; the other, the special ability involved in the memory ratio. This latter would seem to be something that might be called power of retention, the obverse of which is the rate of forgetting. Such an ability is scarcely to be conceived of as an anatomical something, but must rather be looked upon as functional. We could not suppose, for instance, that some special convolution of the brain presided over the rate at which memories deposited in various brain centers faded away. It seems much more in accord with what we know of brain physiology that the permanence of impressions would be an enzyme function—as indeed has actually been suggested by Thomas Brailford Robertson in his autocatalytic theory of memory.[14] So it may be possible for us to distinguish eventually functional abilities from local. The special ability involved in immediate memory may perhaps be something akin to the span of consciousness—whatever that may be in the last analysis. Or it may be akin to perception itself. The correlation between perception and total immediate memory is $0.65 \pm .07$; between perception and the general memory ratio is $0.58 \pm .08$. The difference between the two is thus at the extreme limit of the probable error, lending some color to this hypothesis. The average correlation with all measures of immediate memory with perception is 0.57. The average correlation of all measures of memory ratio with perception is 0.51—a rather insignificant difference, but still pointing in the direction of a partial saturation of immediate memory measurements with perception.

The memory measurement which most taxes the process of perception is that of the memory for pictures. The correlation between immediate memory and perception of pictures is $0.67 \pm .07$. On the other hand, the correlation between memory ratio and perception is only $0.54 \pm .09$. Here the difference between the two is decidedly greater than the probable error. For definite information along this line we should have more

[14] Archives Internationales de Physiologie. 1908, VI, Pp. 388-454.

tests of perception. The discussion thus far will perhaps help to show the complexity of the problem. And the need of finding out empirically tests which measure a definite mental function. It is perhaps impossible to get a pure test of any one function. Any test involves general intelligence plus a greater or less number of special abilities. It should be possible to find tests which involve a given special function or faculty more than others, and these will prove themselves such by correlating higher with each other than with other tests.

Thorndike's method of procedure seems to offer little hope of progress towards finding out the fundamental human abilities. He defines a "single trait" as one "whose varying conditions in men can be measured on one scale,"[15] e.g., reaction time, ability to add, ability to draw lines equal in length to 100 mm., etc. Thus he has proceeded to measure all sorts of human performances and looks upon the ability in any performance, that can be measured by a single scale, as one single trait. But the possibility of measuring products by a single scale does not by any means argue any unity of the producing causes. The height of a tower can be measured in feet, but that does not tell us whether it was built by one man or ten. Thorndike's study, therefore, of performances has thrown very little light on the question of mental functions. Spearman, on the contrary, by constantly improving his methods of research, has been able to demonstrate the existence of a "general intelligence." Psychology must now push these studies further and find out the number and the nature of our mental faculties.

Summary of Conclusions

1. Immediate memory, the power of retention and perception, have a general tendency to deteriorate together.
2. This tendency is not universal, so that it occasionally happens that one of these mental processes deteriorates out of all proportion to the others.
3. Applying the criterion of Hart and Spearman, we find evi-

[15] Educational Psychology, Vol. III, P. 315.

dences for the distinction of immediate memory and the power of retention as two distinct mental functions.

4. The reason why the criterion of Hart and Spearman distinguishes immediate memory from the power of retention, in the present research, is probably to be found in the relatively specific character of the tests employed.
5. The further study of mental functions demands the search for specific tests by empirical rather than analytic methods. A criterion of specificity would be a high correlation of such tests with each other.
6. The recognition of functional abilities, as distinct from local powers bound up with the activity of some definite cortical area, is demanded.

APPENDIX

Corrected Coefficients of Correlation

In an article in the British Journal of Psychology, entitled "Correlation Calculation from Faulty Data,"[1] Spearman gives a valuable formula for correcting correlation ratios for errors of observation or measurement. Such sources of error as, e.g., accidental variations in the subject's degree of attention are impossible to eliminate and will always lower correlation. It is, however, possible to correct for them if we have at least two independent sets of measurements of a subject's ability. It would be interesting to see what correlation values would be obtained were our data subjected to this process of correction. This was accordingly done with the memory measurements by taking as independent observations the average of the first and the fourth, and then the average of the second and the third. These averages were correlated with each other and Spearman's formula applied. Thus the first series of one day average with the last of another day, and the last of one with the first of another. No attempt was made to apply this formula in the case of perception, because it was hard to get two independent series of measurements without repeating the experiments. The following table gives the

[1] 1909-10, III, Pp. 270-295.

corrected coefficients. One need not be surprised that some of the coefficients are a little above unity, for, as Spearman points out, when the true value is near one, correction leads to values either a little above or a little below unity.

The corrected table gives us, as Spearman says it should, about the same results when it comes to a question of correlation of the columns—all values being relatively greater.

TABLE OF COEFFICIENTS CORRECTED FOR ERRORS OF OBSERVATIONS BY SPEARMAN'S FORMULA

	Memory Immediate, Objects	" " Pictures	" " Printed Words	" " Spoken Words	Memory Ratio, Objects	" " Pictures	" " Printed Words	" " Spoken Words	Total Immediate Memory	General Memory Ratio
Memory Immediate, Objects.....		.83	.82	.68	.78	.84	.62	.74	.92	.83
" " Pictures	.83		.95	.63	.63	.68	.52	.82	.97	.74
" " Printed Words	.82	.95		.94	.61	.48	.56	.85	1.06	.60
" " Spoken Words	.68	.63	.94		.45	.30	.25	.79	.95	.38
Memory Ratio, Objects	.78	.63	.61	.45		.96	.73	.79	.62	1.01
" " Pictures	.84	.68	.48	.30	.96		.68	.80	.61	1.07
" " Printed Words..	.62	.52	.56	.25	.73	.68		.91	.48	.86
" " Spoken Words..	.74	.82	.85	.79	.79	.80	.91		.83	95
Total Immediate Memory	.92	.97	1.06	.95	.62	.61	.48	.83		.73
General Memory Ratio	.83	.74	.60	.38	1.01	1.07	.86	.95	.73	